THE NATIONAL WIC EVALUATION

An Evaluation of the Special Supplemental Food Program
for Women, Infants and Children

VOLUME I: SUMMARY

THE NA UATION

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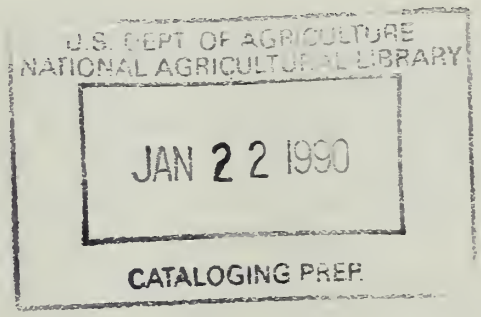
Evaluation of the Special Supplemental Food Program for Women, Infants, and Children (WIC)

Volume I: Summary



Submitted to

Office of Analysis and Evaluation
Food and Nutrition Service
Department of Agriculture

Principal Investigator
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Prepared by

Research Triangle Institute
New York State Research Foundation for Mental Hygiene

Supported by Contract No. 53-3198-9-87

PREFACE

The evaluation of the Special Supplemental Food Program for Women, Infants and Children (WIC), designated here as the National WIC Evaluation, is a project undertaken by the Research Triangle Institute (RTI) under contract with the Office of Analysis and Evaluation, Food and Nutrition Service (FNS), United States Department of Agriculture (Contract No. 53-3198-9-87). The National WIC Evaluation is documented in this summary report and more comprehensively in four technical volumes: Volumes II and III - Technical Report and Volume IV and V - Appendixes. The summary report is written for the reader who wishes a brief nontechnical overview of the WIC program, an explanation of the logic of the National WIC Evaluation, and a discussion of its important results and conclusions. The technical report presents complete discussions of methodology, database construction, analysis techniques, results, and conclusions. The appendixes present copies of all data collection instruments used in the evaluation and supplementary tables referred to in the technical report.

This report covers the four component studies, namely the Historical Study of Pregnancy Outcomes, the Longitudinal Study of Pregnant Women, the Study of Infants and Children, and the Food Expenditures Study, upon which the National WIC Evaluation is based. These studies were designed primarily by the Principal Investigator, Dr. David Rush, with support from RTI staff and consultants, in the fall and winter of 1981-82. Dr. Rush's services, together with a small supporting staff, were made possible through a subcontract with the New York State Research Foundation for Mental Hygiene (NYRFMH).

Actual implementation of the studies began in the summer of 1982, with the major field data collection effort occurring during 1983. While RTI undertook major responsibility for organizing and managing the field effort, processing the data and preparing the basic data files, the entire effort was directed by Dr. Rush and carried out with support from his NYRFMH staff. The major analysis and reporting tasks were also carried out by Dr. Rush and his staff for three of the four component studies, with extensive support from RTI staff. The fourth study, concerned with food expenditures, was analyzed and the report prepared by RTI staff.

The success of the Historical Study was due in large part to the efforts of the State WIC program directors who, with their staff, provided annual counts of WIC women for individual clinics during the period 1974 to 1981. Considerable cooperation was also received from State directors of vital records who provided complete files of births and linked infant deaths for the period 1972 to 1980.

The Longitudinal Study, the Study of Children, and the Food Expenditures Study all acquired data through a national probability sample of pregnant women enrolled in the WIC program and a sample of low-income pregnant women not enrolled in WIC. The success of these samples and the success of the total data collection effort depended in no small part on the excellent cooperation of the directors and staff of the 174 WIC clinics and the directors and staff of the 55 non-WIC clinics that participated in the field phase of the study.

Both the study design and early drafts of this report were reviewed and critiqued by the FNS Advisory Panel to the National WIC Evaluation. The members of this Panel are listed on the inside cover.

The National WIC Evaluation received considerable support and valuable review and advice from the FNS Office of Analysis and Evaluation Project Officers Mr. David Shanklin and Dr. Burleigh Seaver. Particularly helpful were the review and comments of earlier drafts of this report by Dr. Seaver and by Ms. Nancy Chetry of the FNS Special Supplemental Food Division.

Finally, the consistently valuable, timely and able administration of the project by Ms. Sally Johnson is recognized.

D. G. Horvitz
Project Director

CONTENTS

CONTENTS (continued)

FIGURES

TABLES

I. INTRODUCTION

A. THE WIC PROGRAM

1. Description and Program Goals

The Special Supplemental Food Program for Women, Infants, and Children (WIC) is a supplemental food program for low-income pregnant, postpartum, and breastfeeding women; infants; and preschool children. The program is based on two assumptions. One is that inadequate nutritional patterns and health behavior of low-income women and children make them vulnerable to adverse health outcomes. The other is that food interventions at critical periods of growth and development will prevent the occurrence of health problems and improve the health status of participants. The program is federally funded and State administered. Cash grants are made to authorized agencies of each State and to officially recognized Indian tribes or councils that then provide WIC services through local service sites. Priority for the creation of local programs is given to areas whose populations need benefits most, based on high rates of infant mortality, low birthweight, and low income.

The provision of nutritious supplemental foods to needy pregnant women is expected to improve the outcomes of pregnancy. Better nutrition should increase the weight gain of the pregnant woman, increase the length of time the pregnant woman carries the baby (gestational age), and increase the birthweight of her baby. In turn, these increases should reduce fetal* and infant† mortality. For infants and children, the food supplements are intended to reduce the incidence of anemia (low iron) and to improve physical and mental development.

2. Target Population

Under current legislation, participation in the WIC program is open to

- Pregnant women
- Postpartum women (up to 6 months after delivery, if not breastfeeding)
- Breastfeeding women (up to 12 months after delivery)
- Infants (up to 1 year of age)
- Children (up to 5 years of age).

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*Fetal mortality refers to the death of a fetus (i.e., in utero), during the period from 2-months gestation to birth.

†Infant mortality refers to the death of a newborn child during the period from birth through the first 12 months of life.

These women and children must be members of low-income families and be determined by a competent professional to be nutritionally at risk. The Child Nutrition Act of 1966 as amended by Public Law 95-627 defines nutritional risk as one or more of the following:

- Detrimental or abnormal nutritional conditions detectable by biochemical (blood chemistry) or anthropometric (physical) measurements.
- Other documented nutritionally related medical conditions.
- Dietary deficiencies that impair or endanger health.
- Conditions such as alcoholism or drug addiction that make an individual more likely to have inadequate nutritional patterns or nutritionally related medical problems.

"Low-income" is specified as gross family income that does not exceed 185 percent of the nonfarm poverty income defined by the Office of Management and Budget. State WIC agencies have the option to set more stringent eligibility requirements, but not lower than 100 percent of the poverty level, so long as the income requirements correspond to the State's income standards for free or reduced price health care. In Fiscal Year 1984, an average of 3 million persons were enrolled in the program in any given month, at an annual cost of approximately $1.4 billion.

3. Program Benefits

The WIC program aims to improve the health of participants by providing three specific benefits--nutritious supplemental food, nutrition education, and referral to good health care--and thus narrow the gaps in maternal and child health and development associated with poverty.

Supplemental Food

The nutritional needs of each WIC participant are assessed, and supplemental foods are prescribed to provide nutrients lacking in the diet of the individual or of the target population. Public Law 94-105 (November 7, 1975), which authorized the program, specified high-quality protein, iron, calcium, Vitamin A, and Vitamin C as nutrients likely to be eaten in inadequate amounts by the poor. Later legislation (Public Law 95-627, November 10, 1978) was more general and stated that supplemental foods should contain "nutrients determined by nutritional researchers to be lacking in the diets of the targeted population." The food prescription, known as a food package, contains foods such as infant formula, milk or milk products, iron fortified cereal, juice, eggs, and dried beans or peanut butter. It may be tailored to an individual participant's needs within the Federal guidelines.

Nutrition Education

The nutrition education provided by the WIC program places special emphasis on the relationship between proper nutrition and health. Dietary habits that might prevent nutrition-related health problems and the best use of scarce food dollars are stressed. Program regulations require two nutrition education contacts with the participant or principal care-giver during each certification period.

Referral to Health Care

Although the WIC program does not pay for health services, the program encourages the optimal use of existing services, including prenatal and postpartum medical supervision and both preventive and therapeutic infant and child care. Most WIC clinics are located in or near hospitals or public health facilities. WIC is well integrated with providers of health services in many locations.

4. Estimating Program Success

As recently as the spring of 1984, the General Accounting Office, in a review of previous WIC program evaluations (USGAO, 1984), found

> "insufficient evidence for making any general or conclusive judgements about WIC's effectiveness overall. . . . [Past] program evaluations do not reveal whether WIC is having the effect intended by the legislation."

While there have been many attempts to study the effectiveness of the WIC program over its 10-year history, they have been limited in scope. There has not been a comprehensive and systematic evaluation designed to assess on a national scale a wide array of the effects of the WIC program. The purpose of The National WIC Evaluation was to conduct such a study, building on past efforts.

B. OBJECTIVES OF THE NATIONAL WIC EVALUATION

1. Program Evaluation

The objective of The National WIC Evaluation was to estimate effects of participation in the WIC program on nutrition and health during pregnancy and early childhood. Some of the possible impacts of program participation derived from a detailed review of the literature are listed in Figure I-1. They include improved dietary quality, more efficient food purchasing, better use of health services, and improved maternal, fetal and child health and development. In addition, the degree to which WIC foods, intended as supplements, substitute for foods which would have been purchased without the program or are shared with family members, was assessed.

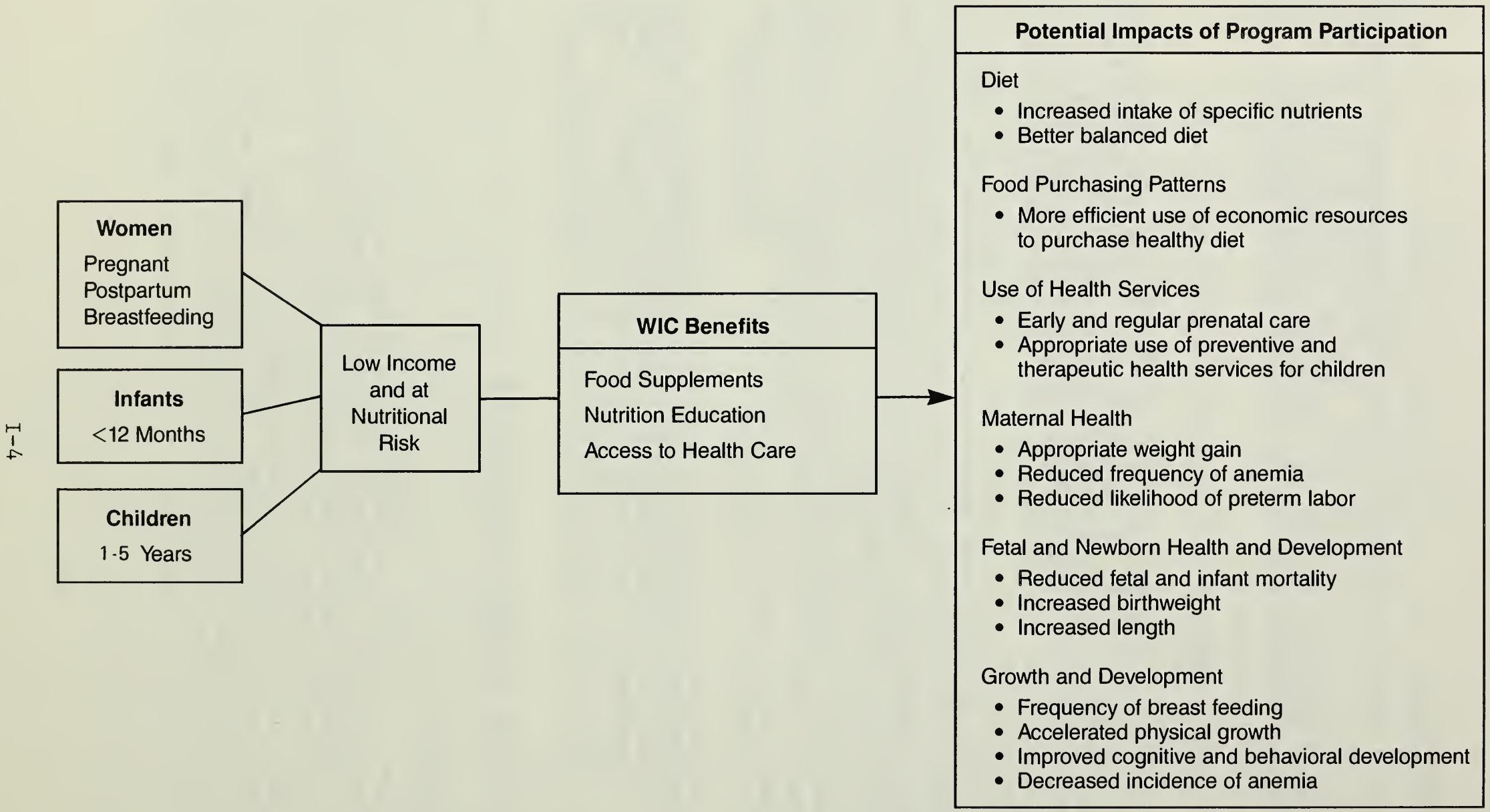

Figure I-1. WIC benefits and potential program impacts.

2. The Need for Both Contemporary and Historical Studies

In order to study the impact of WIC benefits, The National WIC Evaluation employed several research strategies. To assess the effect on diet and nutritional status, on health, and on growth and development, it was necessary to do a current study of pregnant women and children. To determine whether perinatal death rates have been affected, because death is a rare event, it was necessary to study very large numbers of births, many more births than could have been gathered even in a relatively large study of current WIC recipients. Also, a study limited to contemporary births is likely to underestimate the benefits of the WIC program. Over the lifetime of the WIC program, an increasing proportion of the highest risk pregnant women in the population have enrolled in the WIC program, leaving women at lower risk unserved. Thus, a comparison of outcome between women currently enrolled in the program and those not enrolled might be biased against the program.

Over the course of the last decade there has been marked improvement in perinatal* care, with consequent decrease in neonatal† mortality. It was important in this evaluation to understand whether the impact of WIC benefits was either mediated or influenced by this change. The need both to study a very large number of births and to assess past results dictated a complementary historical study of the effects of the WIC program on pregnancy. This study used archival data on WIC participation and relevant vital statistics.

The objectives of the evaluation determined study strategy. The aim was to assess the program across the entire country. The evaluation, therefore, had to be national in scope and had to study program effects on a representative sample of women, infants, and children large enough to yield stable results. The evaluation attempted to estimate effects of the program as actually implemented, and was not limited to ideal, or model, conditions. Also, the WIC program exists with other programs that serve low-income families. The evaluation, therefore, had to assess the impacts of WIC in addition to benefits from Medicaid, Aid to Families with Dependent Children (AFDC), Food Stamps, or other programs, and also whether there were impacts contingent on the receipt of multiple program benefits.

C. DESIGN OF THE NATIONAL WIC EVALUATION

The initial activities of The National WIC Evaluation provided the program description and other information that formed the basis for the evaluation design that later evolved. These activities included assessing the types of information needed by those who would use the results of the evaluation, and an evaluative review of the literature relating to food supplementation. All operating WIC agencies were interviewed by telephone in order to describe program operation. Instruments and procedures to

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*Perinatal refers to the period covering the 29th week of pregnancy through the fourth week following a live birth.

†Neonatal refers to the period covering the first 4 weeks after birth.

measure health and nutrition were developed and field tested for over 5 weeks at three sites.

These initial activities occupied the first 2 years of the evaluation. At that time, the current principal investigator was invited to direct the design of the comprehensive set of studies that form this evaluation. Once the review, which focused on limitations of different study designs and how these limitations might influence the conclusions, was conducted, it served to place The National WIC Evaluation in the context of past research. In addition to this review of all past research of the impact of the WIC program on nutritional and health status, four separate studies were designed and conducted concurrently. Two studies addressed the effects of the WIC program on pregnancy, one using contemporary data collected for this evaluation and the other using historical archival data. A third study assessed the effects of WIC on preschool children, and a fourth examined the economic impact of WIC program benefits on the food purchasing patterns of pregnant WIC participants. Table I-1 is a summary of the outcomes that the program was expected to affect and that were investigated by the four studies. Each of the studies is discussed in greater detail below.

1. Contemporary Studies
   The Longitudinal Study of Pregnant Women

The hypotheses under test in this study were that enrollment in the WIC program would lead to improved diet, accelerated maternal weight gain during pregnancy, prolonged duration of gestation, and increased fetal growth. In addition, improved pregnancy outcome might be mediated by better use of health services and by advantageous health behavior such as reduced cigarette smoking and alcohol intake.

The diets and the course and outcome of pregnancy of 5,205 pregnant women who were first-time registrants for WIC benefits (the WIC group) were compared with those of 1,358 low-income pregnant women not participating in WIC (the non-WIC group) who were first time registrants for prenatal care in either a health department or a hospital prenatal clinic. These latter women served as a comparison, or control group, and the outcome of their pregnancies was compared to that of women receiving WIC benefits. The evaluation assessed the effects of WIC benefits for the mother on

- Use of prenatal care
- Dietary intake
- Weight gain during pregnancy
- Maternal energy storage
- Maternal health behavior (including smoking and alcohol use)
- Duration of gestation
- Breastfeeding

Table I-1

Impact of the WIC Program: Issues Assessed by the Different Studies Constituting the National WIC Evaluation

Potential WIC program impacts	Contemporary studies			Historical study
	Longitudinal Study of Pregnant Women	Study of Infants and Children	Food Expenditures Study	Historical Study of Pregnancy Outcomes
Diet				
Increased intake of specific nutrients	x	x		
Better balanced diets	x	x		
Use of WIC foods	x	x		
Food purchasing patterns			x	
Use of health services				
Earlier and regular prenatal care	x			x
Use of therapeutic health services for children		x		
Maternal health and growth				
Appropriate weight gain	x			
Reduced frequency of anemia	x			
Reduced likelihood of preterm labor	x			x
Fetal and newborn health and development				
Decreased fetal mortality	x			x
Increased birthweight	x			x
Increased length and head circumference	x			
Decreased neonatal mortality				x
Infant and childhood health and development				
Frequency of breastfeeding	x	x		
Improved physical growth		x		
Improved cognitive and behavioral development		x		

and for the newborn on

- Birthweight
- Head circumference and birth length
- Morbidity
- Mortality.

A total of 6,563 pregnant women were recruited into the study in 58 areas chosen randomly from the 48 contiguous States and the District of Columbia, as shown in Figure I-2. In those 58 areas, 174 WIC program sites and 55 health department or hospital prenatal clinics were randomly selected to participate in the study. The sample of women recruited from WIC

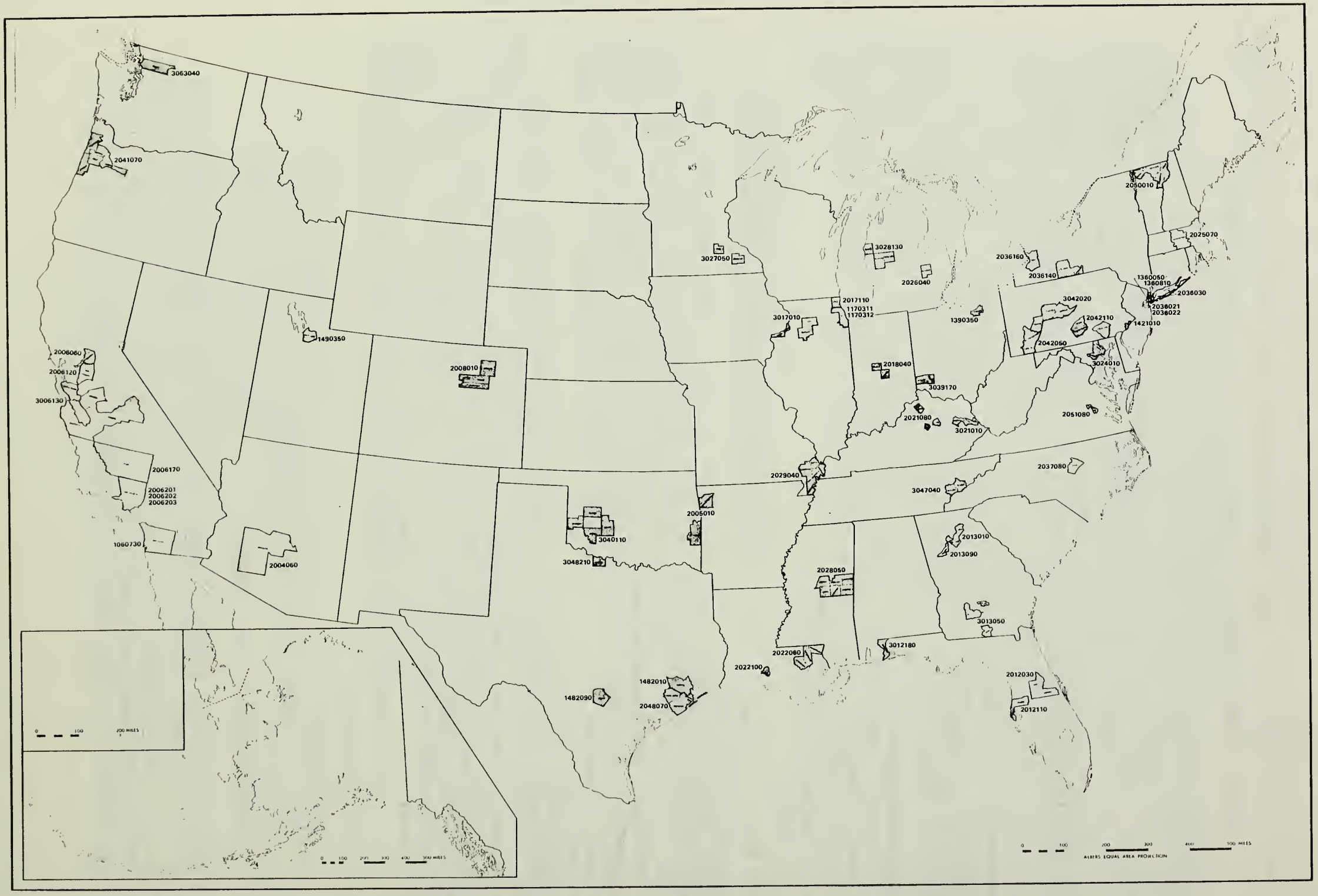

Figure I-2. Primary sampling areas for a study of health and nutrition of mothers and their children.

clinics was nationally representative of all pregnant women participating in WIC, with several minor exceptions. Because of the high cost of working in small programs, the 6 percent of women in the smallest programs were excluded from the sample. In addition, the 34 Indian WIC agencies were excluded because the subsample of Indian women and children would have been too small to draw any conclusions about their special response to the program.

The initial goal was that 2,000 women, or one-third of study subjects, would be controls, but only 1,358 such women entered the study. Control women were recruited only in counties where WIC programs served less than 30 percent of eligible women, or, if the counties were large, where less than 40 percent of eligible women were served. Those recruited were low-income women who were receiving prenatal care for the first time in a hospital or public health clinic. There were fewer such accessible clinics than had been projected, and, therefore, fewer control women were enrolled in the study than had been planned. Further, among control women who received followup evaluation in late pregnancy, over a quarter had enrolled in the WIC program in the interim since recruitment into the study. (For assessment of the effect of the WIC program on some indices, particularly diet, the evaluation was considerably strengthened by this subsequent enrollment in WIC by control group women.)

Data were collected longitudinally; pregnant women were recruited and interviewed at entry into the WIC program or, for control women, into prenatal care, called Time 1 (T1), and were interviewed again at about the eighth month of pregnancy, called Time 2 (T2). There were 181 women initially enrolled in the study as controls who later enrolled in WIC between the first and second interviews. The nature and number of food packages women received from WIC during the course of pregnancy were recorded. Finally, data on outcome of pregnancy were acquired from hospital delivery and newborn records. Abstracts of hospital delivery records were obtained on 75 percent of the study recruits. This reduction in sample size somewhat reduced the ability of the studies to detect effects on birth outcome, but there was no evidence that the subsample was biased or that the study consequently yielded spurious results.

These data were collected by a field staff of 98 field interviewers recruited locally within each of the 58 areas. The interviewers received intensive training in the proper administration of the data collection instruments, which included a recall of all food eaten for the previous 24 hours (24-hour dietary recall) and questionnaires covering past pregnancy(ies); the social, demographic, and economic status of the household; expenditures for food; and use of health care services. In addition, the field interviewer was trained in the use of equipment for taking such physical measurements as height, weight, arm circumference, and skinfold thickness.

These data, provided by direct contact with pregnant women, were supplemented by data descriptive of the WIC or public health clinic in which the pregnant woman was enrolled, including the size of the clinic,

the number of staff and their training, and the nature and content of nutrition education. Also, State WIC Directors rated each of the local clinics involved in the study on the quality of program operations.

An ideal comparison group would consist of individuals identical to those in the program (i.e., receiving the intervention) except for the single difference of WIC program enrollment. As the WIC program has grown, an increasing proportion of pregnant women at highest risk have been recruited into the program, leaving a residual group of unserved women, who were increasingly at lower risk, available to form a control group. In the face of this, one would not expect the control women to be identical to the WIC participants.*

While the ideal of perfectly comparable study and control groups could not be met, the effects on the results of the study of disparities between groups could, in large part, be accounted for in the statistical analysis. Linear multiple regression analysis was used, enabling adjustment or control for characteristics of the pregnant women that might differentiate the study groups as well as influence outcome. In general, noncomparability between WIC and control groups would tend to minimize program effects estimated in the evaluation, thereby possibly masking beneficial program effects. Several methods were available not only to account for noncomparability in the data analyses but also to judge whether estimates of program effects were affected. For example, a test of whether the social disparity between WIC recipients and controls affects estimates of program effect depends upon whether statistical adjustment for a wide array of social and demographic characteristics of the participant and their families changes the estimated relationship of the program outcome. When such adjustment has little effect, social differences are probably only minimally related to the particular outcome under study, and estimates of program effect are unlikely to be a function of noncomparability of WIC recipients and controls.

Study of Infants and Children

Most beneficiaries of WIC are infants and children under the age of 5, yet much less is known about the effects of WIC on their health and well-being than on the pregnant woman. The reasons are not obscure. The effects of change in nutrition in childhood cannot be meaningfully evaluated over a short time span, other than for a few issues such as replenishment of iron stores. There are few noncontroversial criteria of program success and few indices reflecting these criteria. There are no large-scale pre-existing data resources with which to measure outcome, other than death certification, which might be helpful in evaluation. Finally, and importantly, it is very difficult to recruit a truly comparable control group.

The last problem, to recruit comparable controls, and to do so nationally, was one of the greatest challenges to this evaluation. Children

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*In fact, the control women recruited were different than the WIC women socioeconomically. For instance, they were more often white, had higher incomes, were more likely married, and had higher status occupations.

recruited from well child clinics would be getting regular preventive health care, one of the programmatic goals of WIC, and there would be bias against the WIC program in any comparison of rates of immunization or other use of preventive services. Children coming to emergency rooms or hospital clinics would do so because they were sick, and more likely to be less well grown, and less likely to have used preventive services independent of any WIC program effects. Recruiting children from the Headstart Program was considered, but there were limitations to that strategy as well.

The solution was to study the preschool children of the women recruited into the Longitudinal Study of Pregnant Women. Thus, very young infants were underrepresented, but no other obvious special bias was introduced. That the mother was pregnant was unlikely to have had any but minimal effects on the indices under study among children. The mother's enrollment in WIC could have affected the child's dietary intake: the child's dietary recall therefore referred, at latest, to the day after the mother's recruitment into WIC.* Thus, the mother's WIC food should not affect the reported dietary intake of the child. The first few days of the mother's benefits would not appreciably affect either the child's anthropometric or psychological assessment. While the representativeness of the sample of children necessarily reflected that of the pregnant women, the strategy has several important benefits.

Not only were current WIC recipients studied, but an equally large number of preschool children were available who had been WIC recipients in the past, but who were no longer receiving WIC benefits. These past recipients were very valuable to this program evaluation. If the study sample was limited to children who were current WIC recipients the results could have been subject to several additional sources of bias. Program dropouts, children from noncompliant or uncooperative families, would tend to have adverse outcomes, and their exclusion would bias the results to give overestimates of WIC program effects. On the other hand, with scarcity of places in the WIC program for children, children doing well might selectively not have been recertified, while children judged in need of further benefits were recertified. The exclusion of successful children might yield falsely low estimates of program effects. With the sampling strategy used, not only could the proportion of children in each age group who left the WIC program be estimated, but the current status of these children could also be assessed.

The hypotheses tested in the Study of Infants and Children were that enrollment in the WIC program would lead to improved diet and use of health services, and possibly to better physical and psychological development. However, the effects of change in diet and health care over a few months in childhood are too small to measure meaningfully other than in correction of a severe deficiency such as iron deficiency anemia. Thus, a longitudinal study, such as that of pregnant women, would have been of little added value. The Study of Infants and Children was, therefore, cross-sectional,

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*The vast majority of recalls actually refer to the day prior to recruitment.

comparing at one point in time infants and children who were present or past WIC beneficiaries with children not enrolled in the program.

The study assessed the effects of the WIC program on

- Dietary intake
- Height, weight, arm circumference, and skinfold thickness
- Behavior and cognition (vocabulary and digit memory)
- Use of preventive health services (including immunizations and well child care).

The study population was a random subsample of 2,289 preschool children of the women recruited into the Longitudinal Study of Pregnant Women. Thus, some children of pregnant women receiving WIC were also WIC participants, but some were not, and some children of non-WIC women were WIC beneficiaries and some were not. Comparisons were made among the 759 of these children who were currently enrolled in the WIC program, the 691 who had been WIC recipients in the past, and the 839 who had never been enrolled in the program. These 839 children served as the comparison or control group for examining the effect of WIC on diet.

The relationship between enrollment in the WIC program and the use of health services and physical and cognitive growth of these preschool children was assessed by comparing outcomes for 993 children whose mothers were recruited into the program when the children were in utero; 225 children who entered the WIC program during the first 3 months of life, 88 during the rest of the first year, and 105 after the first birthday with 683 children who had never received WIC benefits.

Information on these children was collected from the child's mother when she enrolled in the study and directly on the child within 48 hours of the mother's interview. This latter information was usually collected in the child's home, since the children often did not accompany their mothers when they registered for WIC or prenatal care.

Most of the data analyses used linear multiple regression analysis. Differences across study groups in several characteristics that might affect outcome measures could thus be adjusted statistically.

The Food Expenditures Study

The third of the contemporary studies was an assessment of the extent to which the WIC benefits affect family food purchasing. Past experience suggests that not all food supplements reach the intended recipient either due to sharing with others or due to the displacement of food that would otherwise have been consumed (substitution).

In order to understand the impact of enrollment in the WIC program on family food expenditures, all women enrolled in the Longitudinal Study of Pregnant Women were asked to provide a detailed history of their families' expenditures on food for the month prior to registration into the study; this was repeated during the late pregnancy (second) interview for the prior month.

In addition, a random subsample of 853 women enrolled in the WIC program and 762 women initially enrolled in the control group kept detailed diaries of food expenditures for 1 week following the second interview. The diaries served as a second, independent measure of expenditure as well as a validation of the results obtained by recall.

Both the diaries and the recall data were used to compare food expenditures of the families of WIC and control group women. Recall data were collected twice, and changes in food expenditure patterns could therefore be estimated. Since the diaries were kept for just one time period, only cross-sectional WIC and non-WIC comparisons were possible with the diary data.

2. Historical Study of Pregnancy Outcome

The Historical Study was conducted to determine the effectiveness of the program over its entire history and to permit a sample size large enough to study fetal and infant death rates. This was a national evaluation, and the goal was to estimate the effects of the program that were nationally representative over the entire first decade of the program's existence. Almost all past studies of the WIC program had been limited to, at most, all recipients in one State, for 1 or 2 years. As valuable as such studies were, it was important to assess the effectiveness of the program for a longer duration and across a more diverse population.

There were several compelling reasons for attempting to discover the effectiveness of the program over its entire history. Because the program has grown over time, it can no longer be assumed that the effect of the program is limited to those formally enrolled: the goals and ideology of the program have probably influenced the approach to nutrition in pregnancy and early childhood far beyond the boundaries of the program. Thus, estimates of program effects among contemporary women may not reflect the full impact of the program. Second, the WIC program now serves a larger proportion of the intended, high-risk population, leaving relatively fewer unserved women and children of comparable risk. Therefore, those who have not been involved in the program and who are compared with WIC beneficiaries are likely to be at lower risk that those recruited into the program. Thus, comparisons between current WIC recipients and those not served might tend to underestimate true program effects.

The Historical Study of Pregnancy Outcome, therefore, related WIC participation during pregnancy to both extent and quality of prenatal care and perinatal outcome for the first 7 years of the WIC program (1974 to 1980), and 2 years prior to the inception of WIC during which the Commodity Supplemented Food Programs (CSFP) operated. The hypotheses were that, as

more eligible pregnant women were served by the WIC program, measures of health care should improve, the duration of gestation and birthweight should increase, and perinatal mortality should fall. Further, the effects should be greater on those indices reflecting maternal physiologic status during pregnancy (duration of gestation, birth weight, and fetal mortality) than on infant mortality, which more reflects the quality of health services from onset of labor.

Data from State vital statistics records on all births and fetal and infant deaths were used. The most straightforward approach to the use of these data would have been to link the records of individual mothers who received prenatal WIC benefits to the birth certificates of their children and/or the infant or fetal death certificates. Unfortunately, records of individual WIC participants, other than for the past few years, were generally not retained by State WIC agencies. This study, therefore, links the proportion of eligible pregnant women served by the WIC program each year in individual counties (designated as WIC "penetration") to levels of maternal prenatal care and to the perinatal outcome rates for the same county and year, determined from birth and linked death certificates.

Data from 1,392 counties in 19 States and the District of Columbia, for a total of 11 million births, were available for analysis, although the number of States used in specific analyses varied with the availability of specific items of data. The 19 States were those in which data on WIC participation, by county and linked birth and infant death certificates, were accessible within the constraints of available time and resources. Table I-2 provides a summary of the data available from the Historical Study.

The data for the study period were obtained from several sources. State registrars of vital statistics provided machine-readable files of birth records, fetal death records, and infant death records linked to birth records. Estimates of the number of pregnant women eligible for WIC benefits in each county in the study were derived from U.S. Census data. The numbers of women served by local WIC programs were supplied by State WIC agencies. Data parallel to those for WIC concerning the Commodity Supplemental Food Program (CSFP) were provided by the Food and Nutrition Service (FNS). CSFP also supplies supplemental food to low-income pregnant, postpartum, and breastfeeding women; infants; and children up to age 6 who are at nutritional risk. Although the criteria of eligibility for benefits differ slightly from those of WIC, the programs are similar enough to warrant inclusion of these data in the analysis. The CSFP counts were combined with the WIC recipient counts in each county to compute the level of program penetration (see Figure I-3).

The effect of WIC service was estimated on all births in each county and in each year as well as within county and by year among four subgroups of women defined by race (black or white) and by years of schooling (less

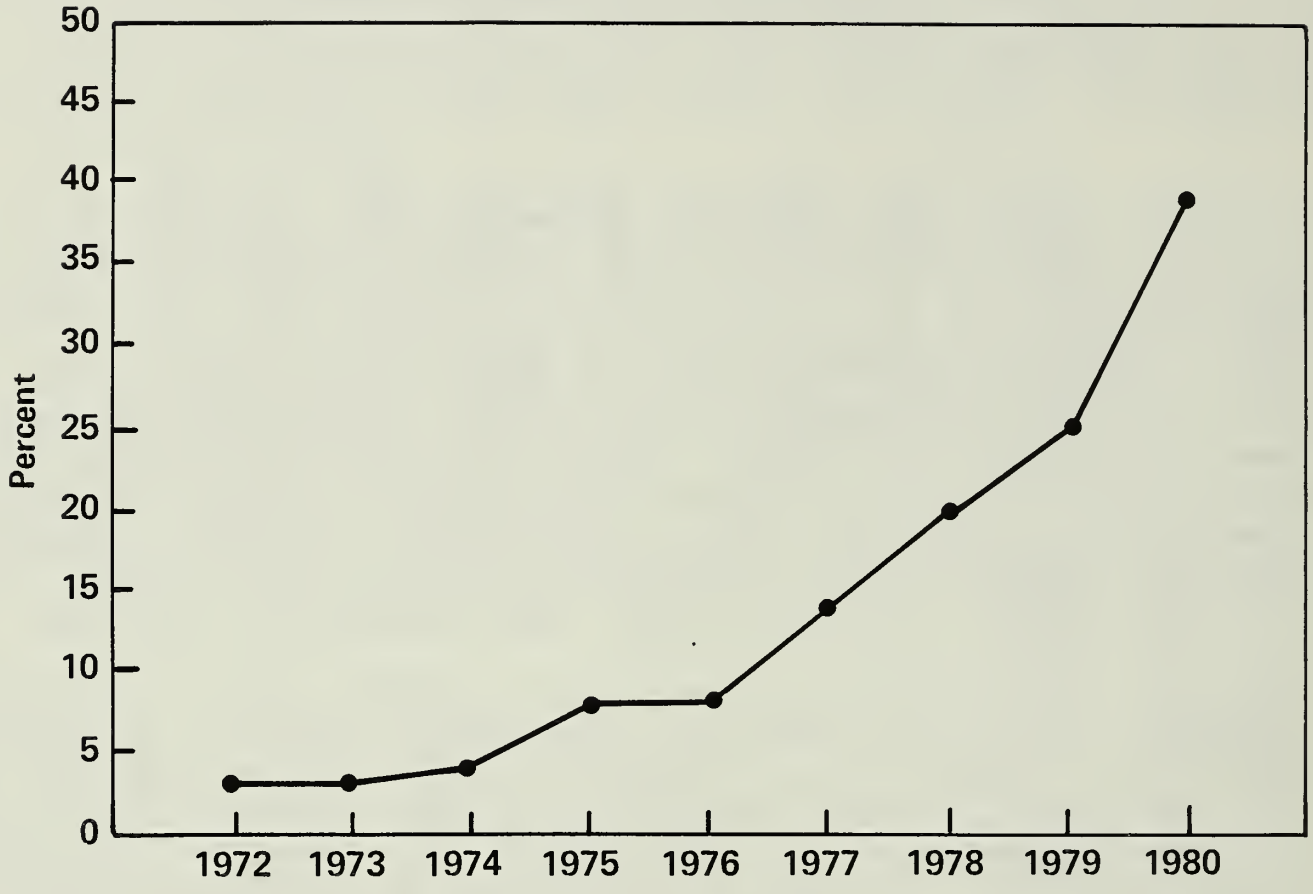
Table I-2

Summary of Data Contained in the Historical Study of Pregnancy Outcome

	Years Outcome Not Available							Analysis By
		Prenatal Care				Mortality		
	Years Penetration Unavailable	1st trimester Entry	Inadequate Care	Duration of Gestation	Birth Weight	Fetal	Infant	Education and Race Possible
Arizona	-	-	-	-	-	72-80	72-79[a]	Yes
Colorado	-	-	-	-	-	72-74	72-76	Yes
District of Columbia	-	-	-	-	-	72-76	-	1973-
Georgia	74-78	72	72	72	-	72-80[a]	72-80[a]	1973
Illinois	-	-	-	-	-	-	72-74	Yes
Iowa	-	-	-	-	-	-	-	Yes
Kansas	-	-	-	-	-	-	72	Yes
Kentucky	-	-	-	-	-	-	-	Yes
Louisiana	75-76	-	-	-	-	-	72-75	Yes
Maine	-	-	-	-	-	-	72	Yes
Michigan	74-76	-	-	-	-	72-80	-	Yes
Mississippi	74-75	-	-	-	-	72-74	72-74	Yes
Missouri	b	-	-	-	-	-	-	Yes
New York State	-	-	72-75	-	-	-	-	Yes
New York City	-	-	-	-	-	-	72-80[a]	Yes
North Carolina	-	-	-	-	-	-	-	Yes
Pennsylvania	-	72-77	72-77	72-77	-	-	-	No
Rhode Island	-	-	-	-	-	72-75	72-75	Yes
South Dakota	75-77	-	-	-	-	72-80	-	Yes
Utah	-	-	-	-	-	-	72,80[a]	Yes
Washington	-	-	-	-	-	-	-	No

[a]Available, but inconsistent with published report.

[b]1978 rate estimated by linear interpolation of 1977 and 1979 penetration.



Note: Combined WIC and CSFP proportion of eligible women served in sample counties. Participation in 1972 and 1973 was entirely in CSFP.

Figure I-13. Average estimated rates of penetration by year.

or more than 12 years). This was done to judge whether the effects of the program were greatest among those presumably in greatest need and most likely to have been enrolled in the program.

The effects of WIC penetration were estimated for

- Adequacy of prenatal care
- Fetal mortality
- Infant mortality
- Duration of gestation (including rate of preterm birth)
- Birthweight (including rate of low birthweight).

To relate WIC service to these outcomes is difficult for several reasons. First, there have been remarkable improvements in perinatal, particularly neonatal, health and survival during the decade under study; second, there have been many other factors influencing perinatal health in addition to the WIC program; and third, the WIC program is selectively directed to areas of greatest need, or, in other words, with worst perinatal outcome.

The analytic techniques of this study contended with these problems by adjusting for differences associated with time and for variation across counties. Thus, estimates of the effect of WIC are over and above the dramatic improvement in infant survival that took place over the decade of study, and they take into account variability between counties. Adjustment for time is, in part, overadjustment, since some of the secular trends in outcome are due to an enlarging WIC program (this was particularly likely for effects on fetal mortality). The approach is conservative; estimates of effect are probably somewhat low.

The effect of adjustment for variability between counties may not be immediately obvious. The analysis assumes three sources of variability, in addition to that due to chance or random variability: change with time, change due to the proportion of eligible women served by WIC (or level of penetration), and differences across counties due to all other sources of variability (the last contributed by the totality of other factors that differentiate one county and its population from another, such as social status, or health care, or ethnicity). In other words, the analysis presumes that each county has its own normal, basal, expected rate of outcome that reflects the characteristics of the county and its population. The estimated effect of the WIC program is over and above both the basal, expected rate and the general trend with time.

The analyses of the Historical Study of Pregnancy Outcome were unlike any used to evaluate the WIC program in the past, either in method or scope. The level of confidence in the results and their meaning depend on whether they are likely to have been affected by the specific inputs of the WIC program and are sufficiently unlikely to have arisen by chance. Thus, it is as important that the pattern of these results be consistent and lead to a logical understanding of the program and its social and medical significance as that the results meet the conventions of statistical significance.

3. Summary of Evaluation Design

The four studies taken together allow examination of the effects of the WIC program on a range of outcomes that would not have been possible from a single study. The contemporary studies were executed simultaneously and permitted efficient and economical collection of information on the pregnant woman, her preschool children, and her family's food expenditures. Variables such as family income, race, maternal and child age, occupation

and employment, and other demographic, health, and socioeconomic information were used in all four studies.

Table I-3 provides a summary of the major outcome variables of the evaluation, the sample sizes associated with each, and the sources of these data.

Table I-3

Summary of Study Outcome Variables and Sample Sizes by Study

WIC program outcome variables	Contemporary studies: Sample sizes of comparison groups: WIC	Controls who became WIC	Controls	Source of data	Historical Study[a]: Number of counties[b]: Race: White education (years): <12	White education (years): 12+	Black education (years): <12	Black education (years): 12+	Total
Pregnant women									
Diet	2,762	181	530	24-hour diet recall, T1, T2					
Mean intake of specific nutrients									
Intake of nutrients from WIC foods									
Mean nutrient density									
Percent below 77 percent of RDA									
Maternal health and growth	3,579	216	601						
Maternal weight gain in pregnancy				T1 and T2 interviews					
Arm circumference				T1 and T2 measurements					
Skinfold thickness				T1 and T2 measurements					
Triceps				T1 and T2 measurements					
Subscapular				T1 and T2 measurements					
Hemoglobin concentration	1,449		478	From clinic records					
Use of health services	3,725	230	729						
Date of first prenatal care				T1 and T2 interviews	475	730	110	118	822
Frequency of prenatal care				T1 and T2 interviews					
Inadequacy of prenatal care					420	674	98	106	765

See footnote at end of table.

(continued)

Table I-3 (continued)

WIC program outcome variables	Contemporary studies: Sample sizes of comparison groups: WIC	Controls who became WIC	Controls	Source of data	Historical Study[a]: Number of counties[b]: Race: White education (years): <12	White education (years): 12+	Black education (years): <12	Black education (years): 12+	Total
Food purchasing patterns									
Expenditures on food	4,219		785	Recall at both interviews					
Expenditures on meals away from home	4,219		785	Recall at both interviews					
Purchase of WIC-type foods	1,031		551	Diary kept at second interview					
Expenditures on food	1,031		551	Diary kept at second interview					
Expenditures on meals away from home	1,031		551	Diary kept at second interview					
Fetus and Newborn Infant									
Fetal growth and development									
Duration of gestation	3,137		904	T1 interview, hospital records	475	729	110	118	822
Birthweight of infant	3,021		869	Hospital records	475	730	110	118	888
Newborn head circumference	2,563		764	Hospital records					
Newborn length	2,834		822						
Fetal and infant survival	3,192		813						
Fetal mortality				T2 interview	437	665	105	111	819
Infant mortality				Hospital records	306	445	83	85	582

See footnote at end of table.

(continued)

Table 1-3 (continued)

Study of Infants and Children

Sample sizes

WIC program outcome variables	Comparison by WIC status			Comparison by age at entry into WIC (months)						Source of data
	Current WIC	Past WIC	Controls	Prenatal	0-3 mo.	4-11 mo.	12+	Unknown	Controls	
Infants and children										
Diet	711	637	763							24-hour diet recall
Mean intake of specific nutrients Mean nutrient intake from WIC foods Mean nutrient density of foods Percent below 77 percent of RDA Intake of whole milk versus formula										
Growth and development:										
Physical growth Length/height Weight Skinfold thickness				993	225	88	105	48	683	Physical measurements
Mental development: Vocabulary Memory Behavior				172	33	18	59	21	182	Psychological test battery
Use of health services:	784	810	939	1,058	237	93	109	51	727	Interviews of mother
Source of routine care Use of well child care Immunization rates										

[a]All data for the Historical Study were from Vital Statistics, Census, and WIC Program records.

[b]The number of counties in a race category varies for those with less than 12 years of education compared to those of 12 or more years because only counties with at least 50 births within a race/education category were included in the analysis.

II. EFFECT OF WIC BENEFITS ON DIET

The array of foods supplied by the WIC program is designed to supplement the intake of such key nutrients as high-quality protein, iron, calcium, Vitamin C, and Vitamin A in the diets of low-income pregnant and postpartum women and of infants and preschool children at nutritional risk.

Quantitative 24-hour dietary recalls were used to estimate dietary intake among over 2,000 preschool children in the Study of Infants and Children. Two such diet recalls were collected on a random subsample of 75 percent of the 6,000 women in the Longitudinal Study of Pregnant Women, at initial interview (before WIC benefits or prenatal care were begun) and again at followup in late pregnancy. The purpose of the diet recalls was to assess change in nutrient intake associated with WIC program enrollment for the women and differences in nutrient intake associated with WIC enrollment among children. Consumption of the foods provided by the WIC program, in conjunction with the nutrition education that is an integral part of the program, should be reflected by improved nutrient intake, mediated by increased intake of WIC-type foods.

Precoded forms were created for women and preschool children to record the dietary intake during the day prior to examination. The forms consisted of lists of foods and beverages most frequently consumed by women and young children. There were 360 foods on the women's form and 422 (all foods on the women's form plus 62 infant foods) on the children's form. Foods reported to have been eaten by study participants that were not precoded were recorded on the form and later manually coded. The dietary recalls were administered directly to pregnant women and to the mothers or caregivers of children and infants. Ninety-eight field workers trained and employed in the evaluation administered the dietary recalls.

The intake of each of 15 nutrients (calories, protein, fat, carbohydrate, calcium, iron, magnesium, phosphorus, Vitamin A, thiamin, riboflavin, niacin, Vitamin B_6, Vitamin B_{12}, and Vitamin C) was estimated by computer translation of the foods consumed into their constituent nutrients. To assess consumption of foods available as supplements from the WIC program, foods potentially available from WIC were identified.

A. THE LONGITUDINAL STUDY OF PREGNANT WOMEN

Only those women who received dietary recalls at both initial and followup interviews were included in the analyses. The initial 24-hour dietary recall referred to a day that preceded any contact with the WIC program or, for control women, prenatal care. The diets of the representative 2,762 women enrolled in the WIC program from the onset of the study and the 181 control women who enrolled in the program between recruitment

and followup were contrasted with the diets of the residual 530 control women.*

1. Mean Nutrient Intake

At late pregnancy followup, women initially enrolled in the WIC program reported eating 111 calories more than control women (see Table II-1). Those who had initially been controls but later enrolled in the WIC program reported eating 142 calories more; both differences were statistically significant.† The differences were entirely accounted for by differences in intake of foods available as WIC food benefits. More than half the incremental calories were supplied by dairy foods, and smaller, equal, amounts from juices and cereals. While these increases in caloric intake may not appear to be very great, they are similar to reported increments in other studies of food supplementation among deprived pregnant women in both developed and developing countries. The increases in caloric intake associated with WIC program enrollment may be important: the mean caloric intake among control women and among those enrolled in the WIC program was far below the Recommended Energy Intake for pregnancy of 2,400 calories for women aged 19 to 21.

Women enrolled in the WIC program also reported significantly greater intake of 14 nutrients: protein, calcium, iron, magnesium, phosphorus, thiamin, riboflavin, niacin, Vitamin B_6, Vitamin B_{12}, and Vitamin C. The mean intake of Vitamin A was not affected significantly by program participation. The WIC program thus achieved significantly increased intakes of four of the five major nutrients initially specified as target nutrients: protein, iron, calcium, and Vitamin C.

The reported levels of incremental energy and protein intake achieved by the WIC program are of the same order of magnitude as in smaller, much more intensively controlled clinical trials of nutritional supplementation in pregnancy. With the exception of Vitamin A, the WIC program appears to have met all reasonable goals in improving the diets of the low-income pregnant women it serves.

2. Mean Nutrient Intake as a Percentage of the Recommended Daily Allowances

Some (but not all) mean nutrient intakes were above the Recommended Daily Allowances (RDAs) (see Figure II-1). However, the RDAs, although

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*Complete information on the 181 control women who enrolled in the program between recruitment and followup is reported in Chapter V of Volume III.

†In this report, differences that were likely not to have arisen by chance less than 1 time in 20, or with a probability (p) of less than 0.05, are defined as "significant." Differences that were likely not to have arisen by chance less than 1 time in 100, or with a probability (p) of less than 0.01, are defined as "highly significant."

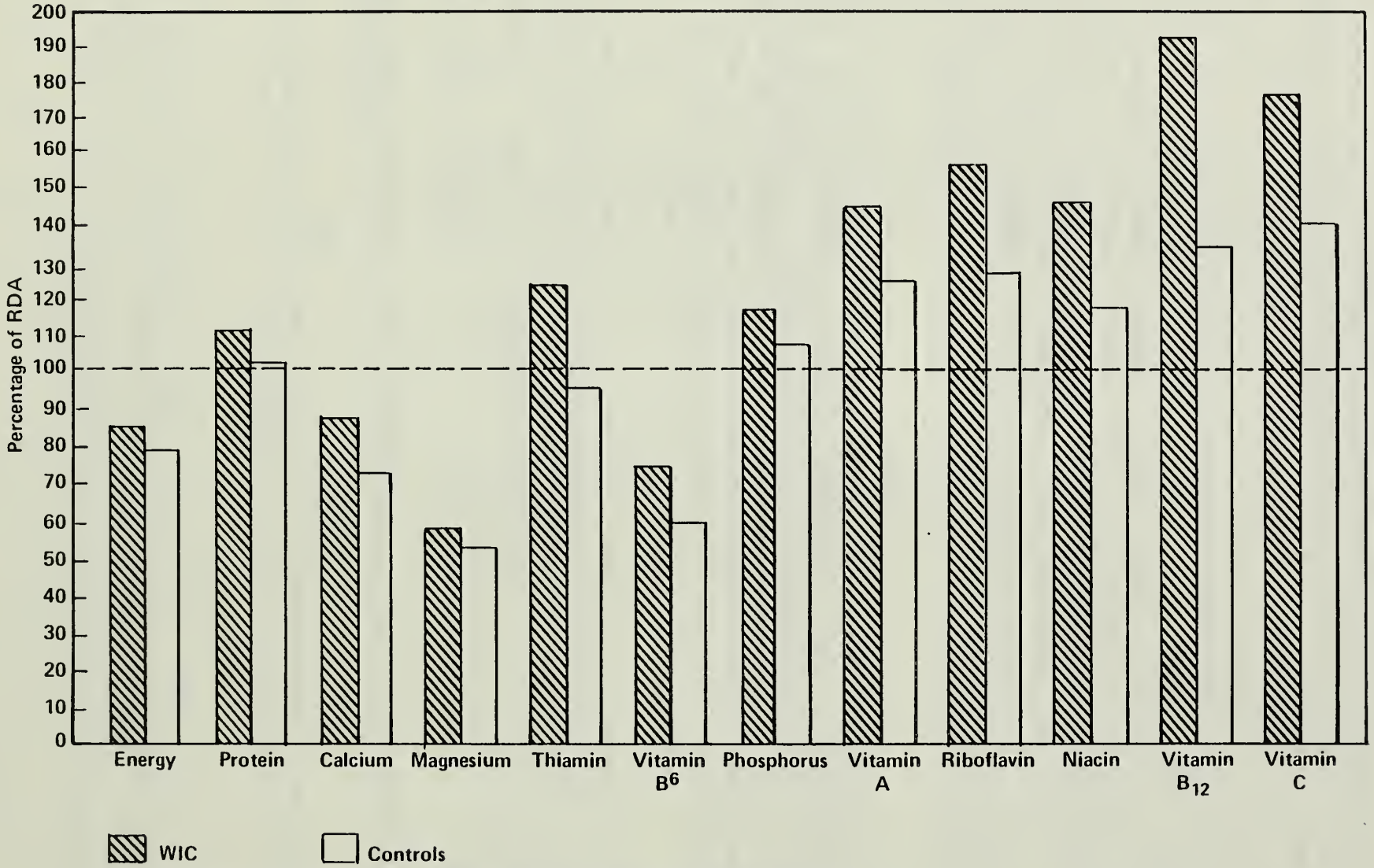
Table II-1

Adjusted Mean Daily Nutrient Intake in Late Pregnancy From 24-Hour Dietary Recalls, Adjusted for Intake at Study Onset[a]

Nutrients	WIC Recipients	Controls	Difference
Calories (kcal)	2,016.1	1,905.3	110.8**
Protein (g)	80.8	75.5	5.3**
Fat (g)	83.2	78.5	4.7*
Carbohydrates (g)	240.8	228.3	12.5*
Calcium (mg)	1,003.7	871.0	132.7***
Iron (mg)	17.2	14.1	3.1***
Magnesium (mg)	269.3	243.8	25.5***
Phosphorus (mg)	1,382.8	1,249.8	133.0***
Vitamin A (IU)	6,887.0	6,109.3	777.7
Thiamin (mg)	1.8	1.4	.4***
Riboflavin (mg)	2.3	2.0	.3***
Niacin (mg)	21.9	18.7	3.2***
Vitamin B_6 (mg)	1.9	1.6	.3***
Vitamin B_{12} (mg)	6.6	5.4	1.2*
Vitamin C (mg)	144.1	111.7	32.4***
n	2,762	530	

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

[a]Total intake and intake from potential WIC foods at followup interview, controlled for initial intake, duration of gestation at both interviews, and maternal characteristics at registration into the study.



Note: Food and Nutrition Board, National Academy of Sciences–National Research Council, 1980, RDA for pregnant women aged 19 to 22. (Nutrient intake adjusted for all maternal characteristics, intake at followup also adjusted for initial intake).

Figure II-1. Average nutrient intake as a percentage of RDA for pregnant women enrolled in WIC and controls.

well informed, are not precise estimates; there are few empirical data that allow RDAs to be based on specific needs in pregnancy for both mother and fetus. The WIC program recruits poor women with demonstrably high risk of poor perinatal outcome. In addition, for several nutrients, the likelihood of low intake on the day of recall was high. For instance, over half of control group women had diets low in 5 of the 12 nutrients for which there are standards (see Table II-2).

3. Rate of Low Nutrient Intake

Program participants reported significantly lower rates of consuming diets low in energy, calcium, magnesium, phosphorus, thiamin, riboflavin, Vitamin B_{12}, and Vitamin C. The likelihood of a diet low in Vitamin A was not significantly affected by program participation.

B. THE STUDY OF INFANTS AND CHILDREN

The Study of Infants and Children studied children of mothers enrolled in the Longitudinal Study of Pregnant Women. The dietary intakes of 711 preschool children who were currently enrolled in the WIC program were compared to those of 637 children who had been enrolled in the WIC program in the past and 763 children who had never been enrolled in the WIC program (control group). There were very few children who were currently or previously enrolled in WIC whose mothers were not also enrolled in WIC. More than half of the control children also were of mothers currently enrolled in WIC. Whether the child was enrolled in the program was more strongly associated with social status than whether the mother was enrolled, possibly reflecting lower priority of children than pregnant women for WIC benefits. Disparities in measured maternal and family health or social and demographic characteristics was adjusted statistically in the data analysis.

Central analyses related dietary intake (estimated from 24-hour dietary recalls) to current WIC benefits, because dietary intake most likely reflects current, rather than past, program enrollment. The indices were total daily nutrient intake, nutrient intake adjusted for caloric intake (nutrient density), nutrient intake from foods potentially supplied by WIC, and the proportion of children who ate diets with less than 77 percent of the RDA of each nutrient (except energy, for which the level was 100 percent of the Recommended Energy Intake). Foods potentially available from the WIC program were further classified as dairy foods, cereals, juices, or other foods. For infants, intake was subdivided into that derived from formula, from other WIC foods, from milk, or from all other foods. (The program provides whole milk to infants only on a case-by-case basis when prescribed by a physician.)

Table II-2

Percentage of Women Eating Diets Low in Specific Nutrients in Late Pregnancy, From 24-Hour Dietary Recalls[a]

Nutrients	WIC Recipients (%)	Controls (%)	WIC Advantage (Controls - WIC, %)
Calories (kcal)	73.2	78.8	5.6**
Protein (g)	29.4	31.8	2.4
Calcium (mg)	51.8	59.8	8.0***
Magnesium (mg)	77.3	84.2	6.9***
Phosphorus (mg)	26.4	32.2	5.8**
Vitamin A (IU)	46.3	50.2	3.9
Thiamin (mg)	38.4	45.2	6.8**
Riboflavin (mg)	22.6	28.0	5.4**
Niacin (mg)	28.2	27.9	.3
Vitamin B_6 (mg)	68.6	72.5	3.9
Vitamin B_{12} (mg)	33.4	39.9	6.4**
Vitamin C (mg)	32.5	41.4	8.9***
n	2,762	530	

*p < 0.05.
**p < 0.01.
***p < 0.001.

[a]Percent less than the 100th percentile of the Recommended Energy Intake for energy, under 77 percent of the Recommended Daily Allowances for all other nutrients. Followup interview controlled for initial intake, duration of gestation at both interviews, and maternal characteristics at registration into the study.

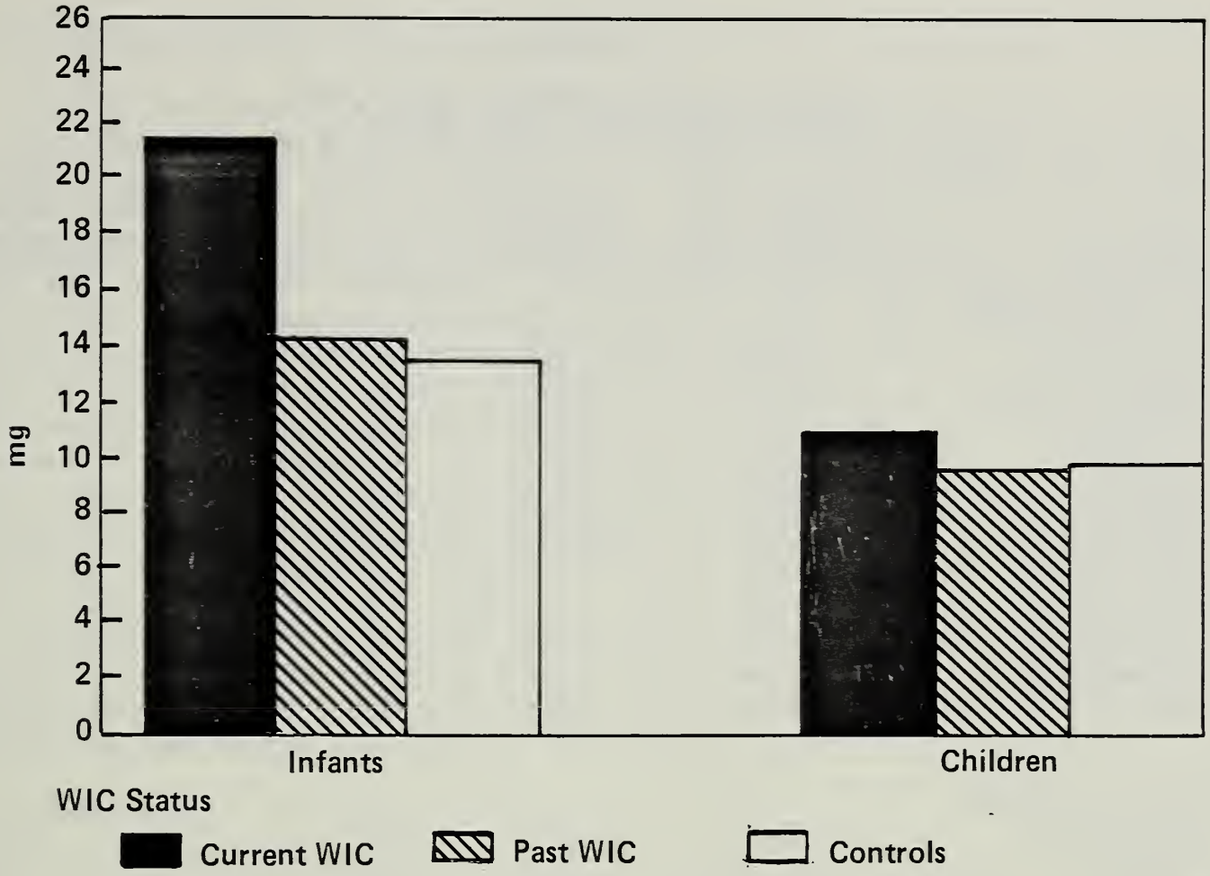


Figure II-2. Mean intake of iron (mg) for infants and children.

1. Average Nutrient Intake

There were large differences in iron intake associated with current WIC enrollment (see Figure II-2). Control infants were reported to consume 13.5 mg a day, and infants enrolled in the WIC program 21.4 mg a day, a difference of 7.9 mg (see Table II-3). The contribution of iron to the diet by the WIC program was significant for both infants and children, but the magnitude was not as great among children (1.2 mg). Differences in intake between current WIC recipients and controls were contributed by foods available from WIC.

Infants enrolled in the WIC program also had significantly greater intake of Vitamin C compared to control infants. Children had significantly higher mean intakes of Vitamin C, thiamin, niacin, and Vitamin B_6. Caloric intake was not significantly related to enrollment in the WIC program.

WIC infants were eating 27.8 g of protein daily, well above the RDA (18.0 g), but significantly less than the intake of control infants. (There was no difference among children.) Physiologically, this lower protein intake was of uncertain impact, but it was very unlikely to have been detrimental.

Table II-3

Adjusted Total Mean Intake for Infants and Children from 24-Hour Dietary Recalls[a]

Nutrients	Current WIC Recipients	Past WIC Recipients	Controls	Difference, Current WIC and Controls	Difference, Past WIC and Controls
Infants (0 to 11 months)					
Calories (kcal)	918.9	967.3	895.8	23.1	71.5
Protein (g)	27.8	36.9	33.1	-5.3**	3.8
Fat (g)	37.7	36.4	35.5	2.2	0.9
Carbohydrates (g)	106.5	123.6	109.4	-2.9	14.2
Calcium (mg)	632.7	861.5	856.5	-223.8**	5.0
Iron (mg)	21.4	14.3	13.5	7.9**	0.8
Magnesium (mg)	123.4	163.5	146.8	-23.4**	16.7
Phosphorus (mg)	575.4	843.7	772.4	-197.0**	71.3
Vitamin A (IU)	3,928.9	6,409.6	3,948.1	-19.2	2,461.5*
Thiamin (mg)	0.9	0.9	0.9	0.0	0.0
Riboflavin (mg)	1.4	1.7	1.6	-0.2	0.1
Niacin (mg)	9.1	9.6	8.1	1.0	1.5
Vitamin B_6 (mg)	0.7	0.9	0.7	0.0	0.2*
Vitamin B_{12} (mg)	2.6	5.4	2.5	0.1	2.9*
Vitamin C (mg)	113.1	98.5	85.7	27.4**	12.8
n	178	84			
Children (1 to 4 years)					
Calories (kcal)	1,172.7	1,160.9	1,167.8	4.9	-6.9
Protein (g)	42.6	42.5	42.7	-0.1	-0.2
Fat (g)	43.5	43.2	43.4	0.1	-0.2
Carbohydrates (g)	156.4	154.9	155.1	1.3	-0.2
Calcium (mg)	693.2	694.9	683.6	9.6	11.4
Iron (mg)	11.1	9.8	9.9	1.2**	-0.1
Magnesium (mg)	167.7	164.9	166.7	1.0	-1.8
Phosphorus (mg)	814.0	816.2	815.3	-1.3	.9
Vitamin A (IU)	4,110.5	3,981.6	3,624.2	486.3	357.4
Thiamin (mg)	1.1	1.0	1.0	0.1*	0.0
Riboflavin (mg)	1.6	1.6	1.5	0.1	0.1
Niacin (mg)	12.3	11.3	11.4	0.9*	-0.1
Vitamin B_6 (mg)	1.2	1.1	1.1	0.1*	0.0
Vitamin B_{12} (mg)	3.7	3.7	3.3	0.4	0.4
Vitamin C (mg)	103.9	88.7	92.1	11.8*	-3.4
n	533	679			

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

[a]Adjusted for a set of covariates. See Table VI-1, Volume III, for a full covariate list.

While the mean intakes of calcium, phosphorus, and magnesium of WIC and control children were similar, the mean intakes of infants enrolled in the WIC program were significantly lower than that of control infants. The origin of these differences among infants is straightforward. Infants in the WIC program were being fed formula almost exclusively, rather than whole milk, and the concentration of these four nutrients is lower in formula than milk.

2. Rates of Low Intake (see Table II-4)

Iron was the nutrient most often lacking in the diets of the control group. Of the control group infants, 54.4 percent had intakes low in iron versus 25.7 percent of infants enrolled in WIC; among children, the rates were 72.6 and 62.3 percent, respectively. The percentage of both infants and children with diets low in Vitamin A was significantly lower among current WIC recipients compared to controls, although mean intake of Vitamin A had not increased by participation in WIC. WIC program participation was also associated with significantly lower rates of low intake of riboflavin and Vitamin B_6 among children, and of Vitamin C among infants. The percentage of infants in the WIC program eating diets low in phosphorus and magnesium was minimally and nonsignificantly greater than controls. However, 20.6 percent of infants in the WIC program had diets low in calcium, significantly greater than the rate of 10.3 percent among controls. The rate of low Vitamin B_6 intake was also significantly higher among infants enrolled in the WIC program. The physiological implications of these differences warrant further discussion and study. The estimates of both calcium and Vitamin B_6 needs in the first year of life are not secure, and neither calcium nor Vitamin B_6 deficiency has been considered a problem in infants in the United States.

C. CONCLUSIONS

The results indicate that pregnant women participating in WIC had greater intake of a number of important nutrients. These included all of the nutrients originally targeted by the program with the exception of Vitamin A. Most of the benefits arose from increased nutrient density, rather than increase of overall dietary intake, although there was also a significant increase in caloric intake bringing women closer to daily Recommended Energy Intakes. These benefits were accounted for by foods available in the WIC package.

The results from dietary recalls suggest that current WIC benefits are improving the quality of diet among infants and preschool children in ways consistent with programmatic goals and that these improvements are mediated by foods supplied by the WIC package. The improvements are limited to those currently enrolled, with little or no residuum from past participation in the program. Infants enrolled in WIC had greater mean intake of iron and Vitamin C than controls, and children in WIC had greater mean intake of iron, Vitamin C, Vitamin B_6, thiamin, and niacin than controls. The proportion of infants consuming diets low in iron, Vitamin A, and Vitamin C was reduced by WIC participation. The proportion of children consuming diets low in iron, Vitamin A, riboflavin, and Vitamin B_6 was also reduced by WIC participation.

The incremental benefits observed, especially past infancy, were dependent not only on increased intake of dairy foods but also on increased intakes of the range of WIC foods. Past infancy, about half of the WIC benefit was contributed by cereals, with important contributions by dairy foods and juices. Also, changes were in nutrient density rather than

Table II-4

Percentage of Infants and Children with Mean Nutrient Intake Less than 77 Percent of RDA (100 Percent for Energy) by Current and Past Receipt of WIC[a]

Nutrients	Current WIC Recipients (%)	Past WIC Recipients (%)	Controls (%)	WIC Advantage: Controls - Current WIC (%)
Infants (0-11 months)				
Calories (kcal)	50.9	46.3	57.9	7.0
Protein (g)	3.8	7.6	4.6	0.8
Calcium (mg)	20.6	17.4	10.3	10.3*
Iron (mg)	25.7	64.4	54.4	28.7**
Magnesium (mg)	6.4	2.5	2.1	4.3
Phosphorus (mg)	8.8	6.7	7.5	1.3
Vitamin A (IU)	9.8	24.8	21.0	11.2*
Thiamin (mg)	3.5	11.1	6.4	2.9
Riboflavin (mg)	3.1	0.0	4.2	1.1
Niacin (mg)	30.6	39.3	38.2	7.6
Vitamin B_6 (mg)	25.0	16.8	14.6	10.4*
Vitamin B_{12} (mg)	10.4	14.7	13.9	3.5
Vitamin C (mg)	9.1	19.4	19.6	10.5*
n	178		84	
Children (1 to 4 years)				
Calories (kcal)	63.6	64.7	64.5	0.9
Protein (g)	7.3	5.8	6.8	0.5
Calcium (mg)	41.6	45.0	43.9	2.3
Iron (mg)	62.3	71.7	72.6	10.3**
Magnesium (mg)	23.8	24.7	24.3	0.5
Phosphorus (mg)	23.7	24.0	25.9	2.2
Vitamin A (IU)	21.3	26.0	27.2	5.9*
Thiamin (mg)	13.3	11.4	12.9	0.4
Riboflavin (mg)	7.6	9.0	11.5	3.9*
Niacin (mg)	26.8	32.4	30.6	3.8
Vitamin B_6 (mg)	28.5	31.0	33.7	5.2*
Vitamin B_{12} (mg)	18.6	19.6	22.6	4.0
Vitamin C (mg)	22.1	27.3	26.6	4.5
n	533		679	

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

[a]Adjusted for a full set of covariates. See Table VI-1, Volume III, for a covariate list.

increased total dietary intake; caloric intake was unaffected by WIC program enrollment. The program affected the quality, not the quantity, of food consumed.

While almost all differences between the diets of past WIC recipients and controls were in the direction of benefit from past enrollment, they were of small magnitude, and none were statistically significant other than a few in infancy. Adjustment for social differences across groups had only trivial effects on estimated program effects, suggesting that better adjustment would not have materially affected the estimates. Therefore, real residual benefits are not likely to have been obscured by these social disparities.

That improvement in diet was associated predominantly with current rather than past WIC participation minimizes the possibility of effects due to observer bias. There was no way that the field worker who performed the recalls could know that analysis would relate current WIC benefits to diet. In addition, the specification of the child's WIC benefits was asked in the maternal questionnaire, remote in time from the child's dietary recall. These results, therefore, appear not likely to have been the result of observer bias in favor of current WIC program recipients.

III. EFFECT OF WIC BENEFITS ON FETAL AND CHILDHOOD GROWTH AND DEVELOPMENT

A. DURATION OF GESTATION AND FETAL GROWTH

The National WIC Evaluation approached the very important question of whether the WIC program had any effect on duration of gestation and fetal growth in two independent studies using very different approaches. In the Historical Study of Pregnancy Outcomes, the extent of WIC program service to eligible pregnant women was related to countywide perinatal outcome for over 11 million births in 1,321 U.S. counties over 9 years. In the Longitudinal Study of Pregnant Women, WIC program enrollment as well as detailed measurements of maternal social status and change in health and nutritional status were related to pregnancy outcome for over 4,000 women for whom hospital delivery and newborn records could be abstracted. The results of both studies will be considered to estimate program effect on duration of gestation and fetal growth.

In the Longitudinal Study of Pregnant Women, there was no significant relationship between WIC benefits on either mean duration of gestation or frequency of preterm delivery. In the Historical Study, there was no relationship between WIC program penetration and the rate of very preterm delivery (under 33 weeks duration), but there was an association at the margin of statistical significance ($p = 0.09$) between WIC and less frequent preterm delivery (under 37 weeks gestation) for the total population. There was significantly longer mean duration of gestation associated with the level of WIC penetration. The estimated reduction in preterm delivery among WIC recipients was 9 per thousand births. Compared to the mean rate for all study women of 66 per thousand, this was a reduction of appreciable magnitude. The estimated increase in mean duration of gestation among those directly served by the WIC program was about 1.4 days. This is not an effect of trivial size and could account for about 30 g increased birthweight (because the fetus grows approximately 20 to 25 g per day towards term).

While there was no significant relationship between the WIC program and very preterm (under 33 weeks) delivery in the total population, there was a statistically significant reduction among white women with fewer than 12 years of education of 8 per thousand births. This is a 33 percent reduction compared to the mean rate for those white women with fewer than 12 years of education.

There was a stronger relationship of WIC benefits to better outcome among both white and black women with less education compared to women with more education. There were large and significant reductions in preterm (under 37 weeks) delivery among less educated white and black women associated with the WIC program. The estimated reduction in preterm delivery among less educated whites was 23 percent (18 per thousand deliveries), and among less educated blacks, WIC enrollment was associated with about a 15 percent reduction (20 per thousand deliveries). The rate of preterm

delivery was unaffected by WIC among more educated women, black or white. The WIC program was also associated with a significantly longer mean duration of gestation of about 1.5 days among less educated whites.

Thus, in the Historical Study, the relationship of WIC penetration with duration of gestation was consistent and strong. The results appear to be reasonably convincing and, given the pattern of strongest results among the less privileged, very unlikely to have been due to simultaneous, correlated changes in health care. The more educated would more likely have had greater access to improved services if general improvement in prenatal services was accounting for the relationship of WIC penetration and duration of gestation. (Other health programs targeted to the poor could theoretically have accounted for these relationships, but the sum of research on this issue is not consistent with this conclusion.)

B. BIRTHWEIGHT

1. Longitudinal Study

In the Longitudinal Study of Pregnant Women, there were no significant differences between the birthweights of infants of women enrolled in the WIC program and those of control women, nor were there differences in the frequency of birthweight under 1,500 g or under 2,500 g. This absence of difference may very well be due to the lower health risk and greater social privilege of control group women, differences that could only partially be accounted for by statistical adjustment.

While these comparisons were not statistically significant, the perceived quality of local WIC programs by State WIC Directors was regularly and significantly related to increased mean birthweight and to decreased frequency of low birthweight.

State WIC Directors were asked to rank each local WIC program from which women were recruited into the Longitudinal Study of Pregnant Women on issues that several State Directors felt distinguished good local program performance, such as quality of nutrition education and efficiency of food package distribution. Replies were received from 22 of 28 States for 135 of the 174 programs in the study serving 2,045 women enrolled in WIC. (Results were thus not available for 39 programs serving 1,112 women.)

Initial analysis of these data in relation to birth outcomes found that an increase of one standardized unit in quality score was associated with 15.9 g greater birthweight, but this difference was not statistically significant. After controlling for duration of gestation, and thus measuring the rate of fetal growth, one standard unit increase in ranking score was associated with 25.6 g greater birthweight ($p = 0.01$). Thus, the estimated difference in mean birthweight among clinics separated in quality by two standard units (say, between the 16th and 84th percentiles of perceived program quality) was 51.2 g, or slightly greater than the effect of the WIC program that originally had been predicted when this study was designed. The frequency of birthweight under 2,500 g was also significantly lower the higher the quality score ($p = 0.01$).

2. Historical Study

In the Historical Study of Pregnancy Outcomes, an increase in mean birthweight of 23 g was estimated for women enrolled in the WIC program. This was significant, and in the range of what had been predicted as a likely effect of the program. Among less educated whites, the birthweight increase associated with WIC was 47 g, and, for more educated whites, 44 g; both relationships were highly significant. Among blacks, the estimated effects of WIC program enrollment on mean birthweight was 26 g for the less educated and 34 g among the more educated. These relationships were not significant ($p = 0.10$ and $p = 0.13$, respectively); but the statistical power of the analyses for blacks was much lower than for whites due to the small number of counties available with reasonably large numbers of black births.

In the total population of study births, the level of WIC penetration was not significantly related to either the proportion of infants with birthweight under 1,500 g or under 2,500 g. The estimated decrease in the proportion of births under 2,500 g was 4 per thousand deliveries among WIC beneficiaries, about 6 to 7 percent of the expected rate of low birthweight in the population recruited into the WIC program. WIC was associated with a reduction in low birthweight of 15 per thousand deliveries among less educated blacks and 18 per thousand deliveries among more educated blacks. While these differences were of substantial magnitude, they were not significant ($p = 0.11$ and $p = 0.07$, respectively).

C. INFANT HEAD CIRCUMFERENCE

Head circumference is not routinely recorded on birth certificates, and therefore could not be studied in the Historical Study. In the Longitudinal Study, while neither the birthweight nor the length of infants of mothers enrolled in WIC were greater than that of controls, the head circumference of infants of women enrolled in WIC was 0.20 cm greater than that of control infants. This difference was highly significant statistically. This unexpected relationship to fetal head growth was parallel to the relationship of WIC participation to head growth in the Study of Infants and Children.

While length or height was greater among control children in that study, as discussed in the next section, there was no parallel difference in head circumference when WIC benefits were begun during the mother's pregnancy. Thus, children whose mothers had received WIC benefits when the child was in utero had head circumference as large, or slightly larger, than control children. This was not statistically significant except among black children. Considering the results on infant head circumference from both studies simultaneously, these findings probably did not arise by chance and most likely were a function of participation in the WIC program by the pregnant women.

D. PHYSICAL GROWTH IN INFANTS AND CHILDREN

1. Classification by Age at First Benefits

In the Study of Infants and Children, the physical growth of preschool children who entered the WIC program at different ages was compared to the stature of children who had never received WIC benefits. The mothers of 993 of the children were recruited into the WIC program when the children were in utero; 225 children entered the program during the first 3 months of life, 88 during the remainder of the first year, and 105 after the first birthday. Of the 2,094 children in the study, 683 had never been enrolled in WIC.

Children were classified by age of first WIC participation because they differed by age in both growth and sociodemographic characteristics, presumably because they were subject to different recruitment priorities at different ages. (For example, the birthweight of those recruited in the first 3 months of life was much lower than controls, while the (statistically adjusted) birthweight of prenatal recruits was significantly higher than that of control children.) Also, the analyses could demonstrate program effects contingent on age of recruitment.

2. Stature

Children who had been involved in the WIC program were, on average, 0.9 cm shorter than controls, ranging from 0.8 to 1.1 cm, depending on the age they first entered the program. This difference among postnatal recruits into the WIC program very likely reflects differential recruitment into the program of short or low-birthweight children, since it is improbable (although not impossible) that the program could have had an adverse effect on child growth. Differential recruitment of small or low-birthweight children cannot explain the consistent decrement in height between prenatal WIC recruits and controls, especially since, at least with adjustment for social differences, prenatal WIC recruits had higher birthweight than controls. This advantage at birth was not sustained.

Those who were first enrolled in the WIC program in early infancy (0 to 3 months) had substantially lower reported birthweights than controls. Low birthweight is one of the risk criteria used to certify children in the WIC program, and differences in current height could, in part, reflect this initial disparity. When adjusted for birthweight, the difference in height between early infancy WIC recruits and controls was reduced by 11 percent.

There is some evidence of greater affect of WIC program benefits among minority children. There was less discrepancy in height among hispanic children who began WIC benefits before their first birthday and comparable controls.

3. Obesity

There were no regular or consistent relationships of WIC program enrollment to several indices of obesity other than a suggestion that children recruited into the program after the first birthday were heavy. While obesity is one of the nutritional disorders that can lead to recruitment into the WIC program, little can be concluded about the effect of program enrollment on obesity.

E. PSYCHOLOGICAL DEVELOPMENT

1. Past Research

The relationship between nutritional status in early human life, whether in utero or early childhood, and later behavior and psychological performance remains a matter of great controversy. Some past studies found increased activity in infancy and early childhood following supplementation. In the two studies in which they were assessed, indices of attention appear to have been improved by prenatal nutritional supplementation; in one study at 15 days, and in the other at 1 year of age. One study found differences in the Brazelton neonatal assessment scale, but another (in which Brazelton was an author) did not. Cognitive changes have rarely been observed and are of great uncertainty. One exception is the study of Hicks et al. (1982), but this was a small study of only 21 sibling pairs. There were no demonstrable defects in young male adults following in utero exposure to the Dutch Famine of 1944-45. In general, past research is consistent with the conclusion that psychological deficits following malnutrition are probably not the direct consequence of malnutrition but rather of the web of adverse social and psychological circumstances that accompany malnutrition (Rush, 1984).

2. Current Study

The relationships between WIC enrollment and behavior and cognition were assessed among 526 four- and five-year-olds in the Study of Infants and Children. Older children were studied because the relationship between test scores and later IQ or behavior is relatively weak among younger children. Behavior was assessed, with the mother as respondent, using the Infant Behavior Inventory (IBI) (Schaeffer and Edgerton, 1976). Cognition was assessed with the Peabody Picture Vocabulary Test (Dunn and Dunn, 1981) and the forward and backward digit memory tasks from the McCarthy Scales of Infant Development (1972).

3. Selection of Tests

The indices used in this evaluation were chosen to address psychological functions predicated from past work to be responsive to differences in nutrition in early life. The IBI assesses the attention and activity of the child. The mother's response to the child's behavior test was also meant to assess her interest in and concern for her child. Digit memory was depressed in one study of children who had been starved in infancy

because of pyloric stenosis (in which food cannot reach the small intestine). The vocabulary test was chosen as a sensitive indicator of general cognitive performance that could be executed within the special constraints of examination in the home by nonprofessional examiners.

4. Findings

There were three statistically significant findings, and each emerged only after social differences between the WIC and control groups were taken into account (in contrast to the anthropometric and dietary analyses, in which there was moderately little modification following adjustment for sociodemographic differences). Controlling only for age and sex, vocabulary performance of prenatal WIC recipients was worse than that of control children, and a significant increment in the favor of prenatal WIC recipients emerged only after adjusting for social differences across study groups.

With such adjustment, prenatal WIC recipients had better vocabulary scores and recruits into WIC after the first year of life had significantly better backward digit memory and combined forward and backward digit memory than control children. There was no significant relationship of child behavior to WIC benefits.

F. CONCLUSIONS (see Table III-1)

1. Physical Growth

Fetal and Infant Growth

From these large studies, using different research designs and studying different populations, it can be concluded that WIC benefits in pregnancy had significant effects on duration of gestation and fetal growth of important magnitudes. In the Historical Study, the estimated increased duration of gestation was 1.4 days, and there were moderately large reductions in the rate of preterm delivery, especially among the less educated women (<12 years of schooling), 23 percent among white and 15 percent among black women compared to the mean rates for all women in these subgroups in the study.

The evidence is somewhat mixed, but it seems reasonable to conclude that WIC benefits were associated with increased mean birthweight in the range of 23 to 47 g, consistent with the great majority of studies of food supplementation among poor pregnant women. The data further suggest that impact on birthweight may depend on quality of program implementation. Future research should include objective measures of the quality of local programs and designs to examine carefully the program factors that lead to greater impacts.

The most serious possible limitation of this analysis is that effects attributed to the intensity of WIC service to eligible women, or WIC penetration, are really due to something else, e.g., improved perinatal care.

Table III-1

Summary of Significant Findings of the Effects of WIC Benefits on Growth and Development

Pregnancy

- Initial low maternal weight gain brought to level of control women (Longitudinal Study)
- Lower late pregnancy fat stores (Longitudinal Study)
- Longer duration of gestation (1.4 days; Historical Study)
- Less frequent preterm birth among less educated, and presently higher risk, women (Historical Study)
- 23 to 47 g higher birthweight (Historical Study)
- Birthweight significantly associated with quality of WIC programs (rated by State WIC Directors; Longitudinal Study).
- Significantly greater head circumference; effect much greater than (minimal) effect on birthweight (Longitudinal Study).

Childhood

- WIC recipients shorter than controls (presently because of program selection criteria), but head circumferences of children who began WIC benefits in early life not smaller than control children
- Vocabulary scores significantly greater than controls among children whose WIC benefits began in utero, and digit memory significantly greater than controls among children with WIC benefits starting after the first birthday.

In technical terms, the estimate of WIC effect would thus be confounded by perinatal care. While such confounding cannot be excluded, there are several reasons to conclude that the results of the study are probably not due to confounding by improved perinatal health services.

The analyses among the four subgroups of births defined by mothers' education and race help to judge the likelihood of confounding. Most countywide confounders, certainly most of those relating to improved perinatal services, should affect those better off socioeconomically as much or more than those less better off, given the way services are usually distributed and used. Thus, if effects attributed to WIC are really due to an association between penetration of the WIC program and availability of high-quality hospital-based services for perinatal care, effects ought to be stronger among the better educated and among whites rather than blacks.

In addition, confounding by improved perinatal services (fetal monitoring, operative obstetrics, neonatal intensive care, etc.) should have almost no effect on birthweight or duration of gestation, only minimal effect on fetal mortality, but large effects on death in infancy. Preventive and therapeutic health care have strong effects on infant death, but at best are weakly related to the other outcomes. The balance and kinds of estimated effects of the WIC program thus help in the judgment of whether confounding of WIC effects with health services effects is likely.

Given two independent observations of differential infant or childhood head growth associated with prenatal WIC benefits, it is confusing why this phenomenon, if real, has not been noted previously. Past studies may have been too small to recognize this effect. The current study is possibly the largest longitudinal study of nutritional supplementation during pregnancy ever performed in which infant head circumference was studied. While the effect on head circumference was statistically significant, it was further strengthened after statistical adjustment for social and demographic disparities across study group. This study accounted in analysis for much of the maternal and familial sociodemographic, medical, and nutritional variability in the data. Past studies may not have been able to account for as much variability. The explanation for this effect depends on further research.

Growth in Children

The WIC program is being targeted towards appropriate children. These children are short in stature relative both to external standards and to the control group and are therefore appropriate beneficiaries of nutritional intervention.

In a recent review of the effects on growth in childhood by food supplementation programs in the developing world, Beaton and Ghassemi (1982) concluded that the effects of such programs on childhood growth are small, except among very deprived children, and that effects on physical activity or on resting metabolic rate are more likely. The results of this study are consistent with their conclusions.

It may be that the relationship of nutritional intervention during childhood to physical growth among children under less than maximal nutritional stress (as U.S. children almost surely are, relative to children in the developing world) may have to be inferred from studies in other areas. In any case, the results of the study reported here suggest that difficulties in recruiting and retaining comparable control children will make controlled studies of impacts on the growth of children unlikely in the future. Further, while the application of post hoc statistical techniques to adjust for differences between control and study populations is useful, the utility of such analysis is still limited. These statistical techniques, while essential, were only partly able to compensate for disparities between WIC and comparison children.

The results for children whose mothers began WIC benefits during pregnancy are less confounded by selective recruitment of short children; prenatal recruits did have an (adjusted) advantage in reported birthweight over controls, which was not sustained. However, these were children at risk to be delivered with low birthweights whose mothers were selectively enrolled into the program because of such risk. The risk factors may have led to later short stature in spite of short-term program effects on birthweight.

2. Psychological Development

Children whose mothers began WIC benefits in the prenatal period had better vocabulary scores than control children, and those who began WIC after their first birthday had better digit memory than controls. Child behavior was not related to WIC benefits. The meaning of these findings is uncertain and implies the need for further research to judge better the relationship of WIC benefits to cognition and behavior in childhood.

IV. EFFECT OF WIC BENEFITS ON THE BODY MEASUREMENTS AND BLOOD HEMOGLOBIN LEVELS OF PREGNANT WOMEN

As reported in previous chapters, the WIC program was associated with both improved maternal diet and outcome of pregnancy. The National WIC Evaluation assessed whether maternal bodily changes (anthropometry) or blood hemoglobin concentration were affected by program enrollment and thus might have mediated or contributed to program effects on perinatal outcome. Changes in weight, arm circumference, and triceps and subscapular skinfold thickness were measured.

Appropriate and adequate weight gain among pregnant women is related to the development of the fetus, and it is reasonable that maternal diet might influence fetal growth by first increasing maternal weight gain. Changes in maternal skinfold thickness during pregnancy were measured for many reasons: the measurements are noninvasive; they are an index of fat stores, which are theorized to be the only form of increased maternal energy storage during pregnancy; their measurement is a component of comprehensive nutritional assessment; they play a role in theories of how nutrition affects the fetus; and they have been predicated to be sensitive indicators of responsiveness to dietary supplementation.

Low blood hemoglobin concentration is one of the possible certification criteria for WIC enrollment. While low hemoglobin level is usually evidence of anemia in pregnancy, this is less certain except at extreme levels. The iron in WIC supplementary foods is aimed at preventing anemia.

The relationship of WIC benefits to change in maternal anthropometry and hemoglobin concentration was studied among the 4,561 women who were re-evaluated in late pregnancy in the Longitudinal Study of Pregnant Women. Of these women, 3,619 were in the group of initial WIC recruits, 225 were control women enrolled in the WIC program subsequent to recruitment in the study, and 717 were non-WIC controls.

A. MATERNAL WEIGHT AND WEIGHT GAIN

Women in the WIC sample were 0.08 kg heavier than controls at initial interview, and control women who were later enrolled in the WIC program were 1.03 kg lighter (neither of these differences was significant). Both of these groups had gained significantly less weight between conception and recruitment into the study than had control women. Initial WIC recruits had gained 0.7 kg less than controls, approximately a 17 percent difference. Thus, the WIC program selectively and appropriately recruited women having low gestational weight gain at the time of entry into the program.

By the time of the late pregnancy followup visit, maternal weight gain among women who were initially enrolled in the WIC program was no longer depressed. Thus, while their weight gain was low at the time of enrollment, from that point onward their gain was comparable to that of controls. Women who were recruited into the control group but who were later enrolled

in the WIC program were at intermediate levels at followup, consistent with a smaller effect, given shorter duration of program benefits. Thus, the program appears to have successfully influenced weight gain in a group of women who had gained significantly less weight in early pregnancy.

B. ARM CIRCUMFERENCE AND SKINFOLD THICKNESS

Change in arm circumference was not significantly associated with WIC benefits. Unexpectedly, women receiving WIC benefits had significantly less increase in skinfold thickness than controls between study enrollment and remeasurement in late pregnancy. There was a highly significant relationship between the duration of WIC benefits and differences in both triceps and subscapular skinfold thickness. Among control women who enrolled in the WIC program before the followup visit, the differences were smaller and not significant, suggesting intermediate effects with less program exposure.

The association between WIC program enrollment and change in maternal skinfold thickness thus appears to have been caused by WIC program participation. This result is counterintuitive, but this is probably the largest (and possibly the only) study that has measured fat deposition in pregnancy longitudinally in relationship to nutritional supplementation, and it is likely that past studies were not able to detect the type of change observed here.

Enrollment in the WIC program may have led either to less energy deposition (as fat stores), or greater mobilization, or both. Possibly, energy was used to metabolize the more nutrient dense diet that women in the WIC program were eating, and thus the reduced increases in skinfold thickness may have been associated with increased metabolic rate. Another possibility is that the energy was put to use by increased maternal activity, the laying down of new maternal tissue, or in the growth or metabolism of the products of conception. The magnitude and statistical significance of these results leave little doubt that they were very unlikely to have been artifactual or chance occurrences. Their origins and their health and physiologic importance must await further research.

C. BLOOD HEMOGLOBIN CONCENTRATION

While iron deficiency in pregnancy is important, assessment is not easy. The most common indices, hemoglobin concentration and hematocrit, are influenced by other factors in addition to iron deficiency and normally decrease in pregnancy. The physiologic decrease is caused by increases in plasma volume greater than increases in red-cell mass. This expansion of plasma volume is strongly correlated with the well-being of the pregnancy in general and fetal growth in particular.

Hemoglobin concentration was not specially measured as part of this evaluation, but hemoglobin values measured during routine prenatal care were abstracted from clinic records. Paired values from both early and late pregnancy were available for 1,449 women in the initial WIC group and

478 initial controls. The initial raw hemoglobin level of women enrolled in the WIC program was significantly lower than that of controls, but there was no difference when the social disparities of the groups were taken into account.

Change in hemoglobin level during pregnancy was nearly identical among WIC women and controls. This was not surprising since the much higher levels of iron intake from special iron supplements, taken by 1,170 women, were also unrelated to either initial or final hemoglobin level.

D. CONCLUSIONS

Women recruited into the WIC program gained significantly less weight from conception to initial interview than control women. Between study recruitment and followup in late pregnancy, their weight gain was the same as that of controls. Thus, significant early disparity in weight gain was reversed during WIC program enrollment. This is likely to have been a program effect and a beneficial one.

WIC benefits were associated with significantly smaller maternal skinfold thickness in late pregnancy. Not only did women enrolled in the WIC program have smaller triceps and subscapular skinfold thickness in late pregnancy than controls, but the differences were significantly related to the duration of WIC program enrollment. While the evidence is strong that the observed differences were unlikely to be due to chance and were probably caused by WIC program participation, it is impossible, from current knowledge, to judge whether such differences were beneficial. A simple interpretation of the change in skinfold thickness (such as, "bigger (or smaller) is better") does not conform with the likely complexity of the relationship between change in energy stores and pregnancy outcome.

Given the beneficial effect of WIC participation on fetal growth, the tentative conclusion is that the pattern of maternal anthropometric change associated with WIC participation, i.e., acceleration and normalization of depressed early pregnancy weight gain, with less fat storage in late pregnancy, was a pattern likely to have been advantageous to the fetus. Certainly, it would likely help the mother to be able to return more easily to her preconceptional weight following delivery. These conclusions are tentative at best, given the paucity of knowledge of the relationship of maternal nutrition, skinfold thickness, and perinatal outcome.

Women who entered the WIC program had significantly lower hemoglobin concentration than controls, but this difference was totally accounted for by sociodemographic disparities between WIC and study groups. WIC program enrollment had no demonstrable effect on hemoglobin concentration, but this was not surprising: there was also no relationship of hemoglobin concentration to the much greater amounts of iron in supplements of elemental iron.

These results are consistent with past experience of little or no response of maternal hemoglobin concentration to iron supplements. Hemo-

globin concentration in pregnancy is not a good index of the adequacy of maternal iron intake, and a serious attempt to ascertain the effects of the WIC program, diet in general, or iron supplements on iron metabolism in pregnancy requires measurement of several more complex concurrent hematologic indices. It would probably be best not to pursue further hematologic studies in pregnancy limited to measuring hemoglobin concentration, since such studies may give a false sense that something valuable and serious may thus be learned.

V. EFFECT OF MATERNAL WIC BENEFITS ON FETAL AND INFANT SURVIVAL

A. LONGITUDINAL STUDY OF PREGNANT WOMEN: FETAL MORTALITY

The analysis of the effect of maternal WIC enrollmen on the rate of survival was confined to a study of fetal mortality because data were collected from women only up to the point of delivery. (Figure V-1 illustrates the various stages of natality.) The analysis was limited to fetal deaths occurring after 20 weeks of gestation for two reasons. First, it is generally no longer possible (or legal) to induce abortion after 20 weeks of gestation. Second, prior to 20 weeks gestation, it is impossible to distinguish with certainty spontaneous from induced fetal loss.

There were 3,192 singleton pregnancies of women recruited into the initial WIC sample. Among them there were 31 fetal deaths, a rate of 9.7 per thousand, and among controls there were 12 fetal deaths among 813 women, a rate of 14.8 thousand. This difference was not statistically significant, but only minimally affected by adjustment in analysis for any group disparities in maternal social or demographic characteristics. Thus, the magnitude of difference was substantial, and unrelated to sociodemographic disparities between the WIC and control groups, but the study was not large enough to test adequately for an effect of this magnitude.

B. HISTORICAL STUDY OF PREGNANCY OUTCOMES: FETAL AND NEONATAL MORTALITY

The analysis of fetal mortality (limited to fetal deaths after 28 weeks duration of gestation) was carried out with the data available for each of the 9 years, 1972 to 1980, for 945 counties (i.e., 8,503 county years of data). The estimated effect derived from this analysis of WIC benefits on the fetal death rate among WIC recipients was a statistically significant reduction of 2.3 per thousand births. Since the mean fetal

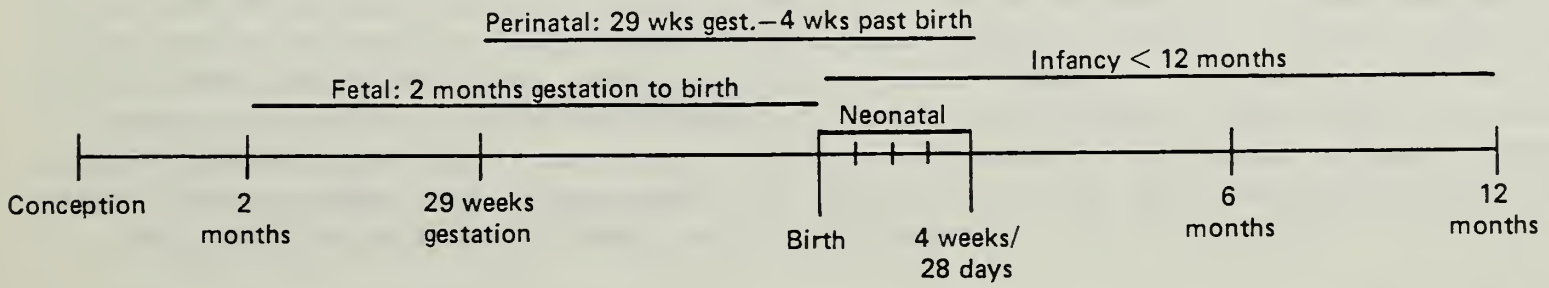


Figure V-1. Illustration of the various stages of natality.

death rate over the 9 years for all women in the counties studied was 6.2 per thousand births, it represents a reduction of over one-third.* The estimated reduction in neonatal death rate (death from birth through the fourth week of life) associated with maternal WIC benefits, while not statistically significant, was of considerable magnitude. Receipt of WIC benefits was associated with a reduction of 2.3 deaths per thousand live births, or a reduction of 22 percent from the mean rate over the 9-year period of 10.6 per thousand live births. Thus, while the estimated reduction is large, this study, as large as it was, was still not large enough to test for a difference of this magnitude. For postneonatal infants, the reduction in mortality was of low magnitude and not statistically significant.

C. CONCLUSIONS

The reductions estimated from WIC program enrollment by the Historical Study, of approximately one-third in fetal mortality and approximately 22 percent in neonatal mortality (not significant), were of large magnitude and were consistent with important program effects. Overall reduction in fetal mortality over the entire decade was only about the same magnitude as that associated with the receipt of WIC benefits (fetal mortality has fallen less than neonatal mortality during this period). The relative contribution of the WIC program may thus have been much greater to fetal mortality than to change in other indices of perinatal health. This important possible contribution of the WIC program, relative to other factors, again suggests that the effects of the WIC program were not mediated predominantly by change in the quality of health care, which probably has been responsible for most of the dramatic fall in neonatal mortality, but rather in factors that are relatively less amenable to change in medical care and more likely related to the nutritional status and physiologic well being of the mother.

These results, while only statistically significant for the relationship of WIC program penetration to decreased fetal mortality, are consistent with major benefits from the nutritional component of WIC participation on mortality before and around the time of birth, but not on infant mortality later in the first year of life. Postneonatal mortality is most responsive to both social circumstances and to traditional preventive and therapeutic health care, and neonatal mortality is responsive to intensive perinatal health services. On the other hand, fetal mortality has been relatively unresponsive to health care inputs. Thus, the results of this study are consistent with the WIC program functioning as much, or more, through improving the mother's physiological status during pregnancy than through changes in accessibility to, and use of, health services. This interpretation is also reflected by the significant improvements in duration of gestation and birthweight associated with the WIC program.

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*The mean fetal death rate among all women eligible for WIC was probably greater than 6.2 per 1,000 births, but was not estimable from the data available.

VI. EFFECT OF WIC PROGRAM PARTICIPATION ON THE USE OF HEALTH SERVICES AND HEALTH PROMOTING BEHAVIOR

Referral to appropriate health care is one of the key services provided by the WIC program. Low-income pregnant women frequently underutilize prenatal services, despite high rates of adverse pregnancy outcome. The WIC program is mandated to encourage these women to begin prenatal care early in pregnancy and to continue regular health care throughout pregnancy and the postpartum period. In addition, the program is supposed to encourage pregnant women to modify their health behavior if appropriate, such as reducing or eliminating cigarette and alcohol use.

Many low-income children do not receive adequate health care, and the WIC program intervenes by appropriate referral. Curative and preventive health care for infants and preschool children, including immunization, is encouraged by WIC. The National WIC Evaluation studied use of health services and health-related behavior among pregnant women and infants and children.

A. HEALTH SERVICE USE DURING PREGNANCY

1. Early Registration for Prenatal Care

In the Historical Study of Pregnancy Outcomes, 73.9 percent of all women registered for prenatal care during the first trimester (with very large differences associated with both maternal race and education). There was a significant increase in first trimester registration associated with increased numbers of eligible women enrolled by the WIC program. The estimated increase in first trimester registration among women enrolled in the program was about 41 per thousand, or an increase of 5.6 percent over the base rate. The relationship of WIC program participation to first trimester registration was much stronger among blacks than whites, and among women with less, rather than more, education. The greatest effects were thus among groups at greatest need, who were also women with lowest rates of early registration without WIC services.

Findings from the Longitudinal Study of Pregnant Women are more limited in scope regarding early registration. The structure of the analysis files for the Longitudinal Study did not permit a direct comparison of early registration rates between the WIC and control groups, but the proportion of pregnant women entering WIC, by trimester of pregnancy, was calculated based on data from the WIC sample screening instrument. Approximately 25 percent of all women enrolling for prenatal WIC services were in their first trimester of pregnancy, 49 percent were in their second trimester, and 26 percent were in their third trimester.

2. Adequacy of Prenatal Care

The adequacy of prenatal health care was studied in both the Longitudinal Study of Pregnant Women and in the Historical Study of Pregnancy

Outcomes. Adequacy was defined in both studies in terms of the frequency of health care visits during pregnancy, but the method of computing frequency differed.

In the Longitudinal Study, the number of prenatal visits from study entry until late pregnancy followup, adjusted for the length of time between the two visits, was related to WIC program enrollment. This was equivalent to the rate, or frequency, of visits for health care. There was no difference in the frequency of visits for prenatal care among women enrolled in the WIC program compared to control women. Since the frequency of prenatal visits only relates to perinatal outcome when markedly inadequate (Gortmaker, 1979), the Longitudinal Study was probably too small to test for a meaningful change.

In the Historical Study, the definition developed by Kessner et al. (1973), and modified by Gortmaker (1979), was used to determine the adequacy of prenatal care. It is based on the number of visits for prenatal care, adjusted for the duration of gestation, and then categorized into two groups: inadequate versus intermediate or adequate. There was a strong and highly significant association between the level of maternal WIC service and reduction in rates of inadequate care. Over the entire study period, 63 pregnant women per thousand were estimated to be receiving inadequate numbers of visits for prenatal care. If the reduction countywide associated with the level of maternal WIC services was contributed entirely by those directly served by the program, the estimated reduction among them was about 50 per thousand. The estimated reductions in rates of inadequate care associated with WIC program benefits were larger among those in greatest need, women with less education (whether white or black) whose background rates of inadequate number of visits were also higher than women with 12 or more years of schooling.

In the Historical Study, there is some circularity in the relationship between the level of WIC service and any outcome correlated with duration of gestation (such as first trimester registration for prenatal care, but not with adequacy of care, which is adjusted for duration of gestation). This effect is almost certainly very small.

There can be no certainty as to whether greater amounts of WIC service led to early registration for health care, or whether earlier contact with health care led to more frequent WIC benefits. It is possible that early registration for care, or more frequent care, could have led to greater WIC program participation, and even (theoretically) mediated the associations between extent of WIC services and improved perinatal outcome. While this is logically possible, the pattern of the results in the Historical Study is inconsistent with this conclusion. Improved pre- and perinatal health care over the last 15 years has had a profound effect on neonatal mortality, but much less on fetal mortality (only that relatively small proportion of fetal mortality contributed by intrapartum death), and almost none on duration of gestation or on fetal growth. In fact, the WIC program was most strongly associated with just those perinatal outcomes that were least likely to change by improved health services, making it unlikely that

better health services were the origin of both increased WIC utilization and improved perinatal outcome, or that better health services mediated the effect of WIC on perinatal outcome.

B. CHANGE IN NUMBERS OF HOURS WORKED DURING PREGNANCY

In the Longitudinal Study of Pregnant Women, 692 women reported working full or part time at initial interview. Between registration into the study and followup in late pregnancy, there was no significant difference in the reduction in number of hours worked associated with WIC enrollment. Thus, there was no evidence that the economic benefits of the WIC program were used by mothers as an income supplement, at least to the extent that they did not reduce the amount of time worked, compared to control women.

C. CIGARETTE SMOKING AND ALCOHOL INTAKE

At registration into the Longitudinal Study, women enrolled in WIC were smoking significantly fewer cigarettes daily than were control women. At the followup visit, women in the WIC group had increased their smoking slightly, but not significantly more than controls. It appears that the WIC program had no relationship, one way or the other, to change in numbers of cigarettes smoked. Thus, this may be an important issue for possible future programmatic attention.

At registration into the study, women enrolled in WIC reported consuming significantly less alcohol than control women. At followup visit, there was a slightly, but not significantly, greater increase in alcohol intake among women in the WIC program compared to control women. As with cigarette smoking, there appears to be no detectable effect of intervention by the WIC program on reduced intake of alcohol during pregnancy.

There was no relationship between State WIC Managers' estimation of local WIC program quality and effectiveness and change in either cigarette smoking or alcohol intake.

D. BREASTFEEDING

Breastfeeding and WIC program participation were assessed in the Longitudinal Study of Pregnant Women in three ways. The mothers of preschool children were asked whether, and how long, they nursed their children and pregnant women were asked at followup visits in late pregnancy whether they planned to breastfeed after their children were born. Data on whether the woman was breastfeeding at hospital discharge were abstracted from the hospital newborn record.

In the Study of Infants and Children, if the mother had been enrolled in the WIC program during pregnancy, she was significantly less likely to have breastfed her infant for greater duration than a control woman. This difference was entirely accounted for by social and demographic differences between WIC recipients and control women. Among the 796 infants who had been breastfed, the mean duration of breastfeeding was 155 days. Infants

whose mothers received prenatal WIC benefits were breastfed five and a half days longer than control infants, but this difference was not statistically significant.

In the Longitudinal Study of Pregnant Women, fewer women enrolled in WIC planned to nurse their infants than did control women, but the difference was not significant. There was a significant relationship between the method of infant feeding counselled by health care personnel and that planned by the mother: it was more likely that a woman planned to breastfeed if breastfeeding was (reported to have been) advised.

The rate of breastfeeding after delivery (abstracted from hospital records) was unrelated to WIC program participation. Whether and how long breastfeeding was sustained was unknown because study followup ended at hospital discharge.

Thus, there was little evidence of any relationship between WIC program participation and frequency or duration of breastfeeding, but in order to assess optimally whether there was any effect of the program, further followup of mothers and infants would be necessary.

E. USE OF HEALTH SERVICES AND IMMUNIZATION AMONG PRESCHOOL CHILDREN

Among children enrolled in the Study of Infants and Children, children recruited into WIC under 1 year of age were significantly more likely to have a regular source of health care than control children. However, a child may have been enrolled in WIC because he or she was a patient in a clinic, rather than vice versa. The study of preschool children was cross-sectional, and, therefore, the time sequence of this relationship could not be specified.

Use of preventive health services was defined as a history of having taken the child to a medical provider for a routine checkup, immunization, or examination during the past year when the child was not sick. There was no relationship between enrollment in the WIC program and recent use of preventive health care.

Although adequacy of immunization is not specifically defined as a goal of the WIC program, it is an index of one element of good preventive health care, which is a program goal. Adequacy was assessed in four ways:

- Whether the mother had a written record of the child's immunizations.
- Whether the child had received a measles vaccination (only estimated among children who were over 15 months of age).
- Whether the DPT status of the child was adequate (the criteria of adequacy were three injections under 18 months of age and four injections over that age).

- Whether the child had received adequate polio vaccination (the criteria were two doses of vaccine under 18 months of age and three doses over that age).

Children who entered the WIC program after their first birthday were significantly more likely to have immunization cards. Those recruited during the first year of life were more likely to have a card, but differences were not significant, and among prenatal recruits there was no difference from control children. WIC children recruited after their first birthday were significantly more likely to have received measles vaccination than control children.

WIC recruits in utero or under 1 year of age were significantly more likely to have received adequate DPT immunization, and those recruited over 1 year were also more likely to be adequately immunized, but not significantly so. (Among children whose mothers were enrolled in the WIC program during pregnancy, it was not possible that the causal sequence was immunization (e.g., clinic attendance) leading to enrollment in WIC.)

Children recruited into the WIC program in the first 3 months of life were significantly more likely to have adequate polio immunization than controls, and children of mothers who entered the program during pregnancy also were more likely to be adequately immunized (71.6 percent, versus 67.0 percent among control children), but this difference was not significant.

The percentage of children immunized, by age of WIC program inception, for measles, DPT, and polio are summarized in Figure VI-1.

F. CONCLUSIONS

The evidence from this evaluation is that the WIC program is associated with a reduction in inadequate prenatal health care, a reduction likely to be beneficial to the mother and infant. Among infants and children, the immunization status of children enrolled in WIC in early life (with the exception of measles vaccination) appeared to be better than controls.

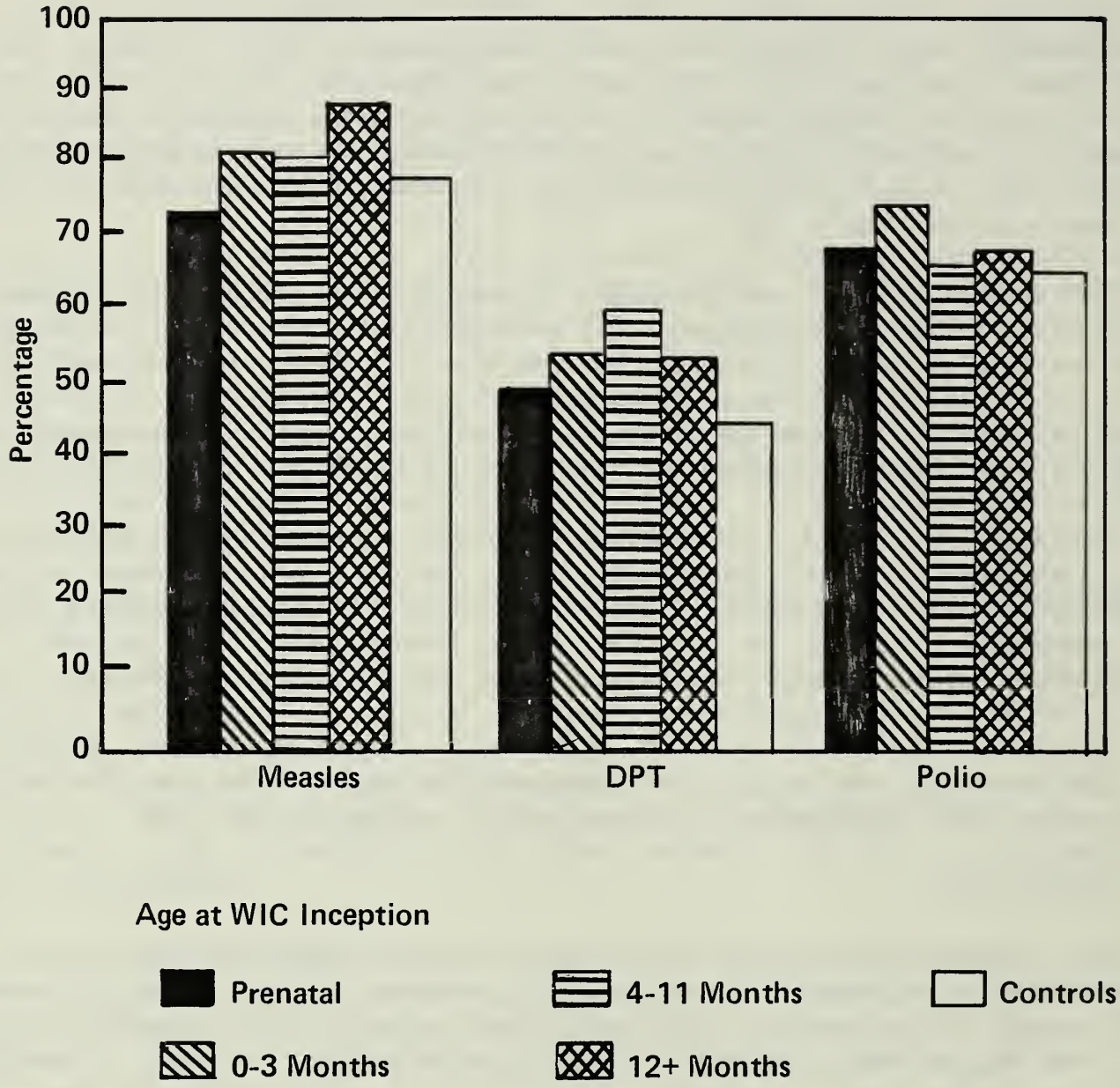

Figure VI-1. Percentage of children immunized by age of WIC inception.

VII. EFFECT OF WIC BENEFITS ON FAMILY FOOD EXPENDITURES

A. OVERVIEW

1. Substitution and Sharing

The objective of this component of The National WIC Evaluation was to investigate the extent to which the WIC food benefits supplement the diet of the WIC recipient. Previous experience with food assistance programs indicates that there may be a difference between the value of supplemental food assistance and the value of increased food intake of the intended recipient (Basiotis et al., 1983; Smallwood and Blaylock, 1983), either due to sharing of the supplemental food with other family members and/or displacement of food that otherwise would have been consumed by the recipient (substitution).

In The National WIC Evaluation, substitution and sharing have been distinguished as follows: The WIC participant receives a WIC food instrument that allows the family to purchase specific foods. If the total increase in food expenditures equals the value of the WIC package, no substitution has occurred. If the family increases its food expenditures by the value of the WIC package and if the extra food is consumed by other family members as well as the designated WIC participant, the food has been shared. The amount of sharing equals the increased food consumption by family members other than the WIC participant. Alternatively, if food expenditures do not increase and if the participant does not increase her consumption of designated WIC foods, substitution has occurred and the WIC package has allowed the family to increase its consumption of goods other than WIC foods.

The behavior of families with respect to expenditures and consumption of WIC foods and other goods and services in response to receipt of WIC benefits is more complex and variable than in the examples. Additional food may be purchased, but consumption may not increase, due either to wastage or to purchase of more expensive foods. On the other hand, the family may not increase its food expenditures but could improve its consumption patterns because of nutrition education or food purchase information received from the WIC program, leading to more efficient food expenditures.

2. WIC and Non-WIC Family Comparisons

The study combined the use of recall and diary methods to collect family food expenditures, thus permitting longitudinal and cross-sectional comparisons between WIC and non-WIC families. The respondents were the pregnant women participating in the Longitudinal Study of Pregnant Women. During the initial clinic enrollment interview (Time 1), all WIC and non-WIC respondents were asked to specify by recall their average monthly expenditures for food and beverages for the month immediately preceding the interview. The questions used were comparable to those used in the U.S.

Quarterly Consumer Expenditure Surveys. These questions were repeated during the second interview late in the pregnancy (Time 2). Usable data on food expenditures based on recall information were collected from 4,219 WIC women and 785 non-WIC women at Time 1 and Time 2.

Characteristics of these sample families are summarized in Table VII-1. In general, the non-WIC families seem to be economically more advantaged than WIC families. Total family income is higher for non-WIC families and a higher proportion of the non-WIC women have a high school education. A larger proportion of WIC families than non-WIC families is black. Finally, WIC families receive about twice as much in Food Stamps as do non-WIC families.

At the second interview, in addition to the recall assessment of food expenditures, a random subsample of WIC and non-WIC women was asked to keep a diary of their detailed food purchases for a 1-week period using a ledger-type diary. These diary data are especially useful because of the greater detail they provide about the types of food purchased (see Table VII-2).* The numbers completing the food purchase diary were 1,031 WIC women and 551 non-WIC women (reflects switchover of approximately 180 initial control cases to WIC cases).

3. Analytic Methods

A two-stage econometric model of food expenditures was developed to analyze the recall data for WIC effects. A similar one-stage model was used to analyze the diary data. Both models were used to estimate and test for WIC effects on total food expenditures, grocery expenditures, and expenditures for meals away from home, controlling for household composition and income. In addition, analyses of expenditures on WIC-type foods, as well as non-WIC foods by category, were carried out with the diary data.

B. FINDINGS

1. Substitution and Sharing

Analysis of the recall data indicates no statistically significant increase in food expenditures between the Time 1 and Time 2 interviews attributable to participation in the WIC program. The results from the food expenditure recall data therefore suggest that substitution accounts for the entire value of the WIC package. There was also no statistically significant evidence of sharing.

These findings, however, do not imply a lack of impact for the WIC program. Participation in the WIC program was found to be strongly associated with a tendency to spend less on meals away from home. Based on the

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*In general, 1-week diary records are not representative of average long-term family food expenditures; it is therefore, not appropriate to multiply weekly data to estimate monthly expenditures.

Table VII-1

Selected Socioeconomic Characteristics of WIC and Non-WIC Families Recall Data

Selected variables		Recall data[a] WIC n=4,219	Recall data[a] non-WIC n=785
Total family income ($/month)		582.04	739.38
No. of children age 1 to 5		0.63	0.55
No. of other family members		1.98	1.89
Percent Black		31.19	19.20
Percent White		49.08	56.90
Percent Hispanic		17.91	21.40
Education of women			
Percent 12 years or more		34.13	42.54
Food Stamps ($/month)		70.02	35.36
Total food expenditures ($/month)	T(1)	199.77	213.98
	T(2)	210.04	223.15
Grocery expenditures ($/month)	T(1)	160.64	166.12
	T(2)	170.68	171.21
Meals away from home ($/month)	T(1)	11.73	21.91
	T(2)	12.37	21.19

[a]Recall data are shown as $/month.

Table VII-2

Selected Socioeconomic Characteristics of WIC and Non-WIC Families Diary Data

Selected variables	Diary data[a] WIC n=1,031	Diary data[a] non-WIC n=551
Total family income ($/month)	140.75	175.06
No. of children age 1 to 5	0.61	0.54
No. of other family members	1.95	1.87
Percent Black	29.00	17.60
Percent White	50.72	56.98
Percent Hispanic	18.52	23.41
Education of women Percent 12 years or more	33.36	43.01
Food Stamps ($/month)	16.30	7.94
Total food expenditures ($/month) (T2)	64.06	62.85
Grocery expenditures ($/month) (T2)	54.44	49.15
Meals away from home ($/month) (T2)	9.61	13.69
Expenditures by food group ($/week)		
WIC-type foods	12.76	8.13
Meat	15.27	15.11
Condiments	6.09	6.00
Cereals and breads	6.86	7.14
Fresh foods	20.35	21.15
Frozen foods	4.14	3.58
Vegetables	7.65	7.11
Dairy	1.59	1.46
Beverages	4.09	4.07

[a]Weekly diary data are reported as $/week.

recall data, families of pregnant women participating in WIC were estimated to spend $5.16 less per month on meals eaten out than the families of non-WIC women. Moreover, families with a WIC woman and one additional adult spend $7.02 less per month on meals away from home than non-WIC families. This estimate also suggests that WIC program participation contributes to a larger proportion of home-cooked meals in the family diet. Since meals away from home have an implicit cost for service and tend, therefore, to be more expensive per unit of nutrients than home-cooked meals, the WIC program fosters a more efficient use of the family's food budget.

2. Impact of WIC on Food Expenditure Patterns

The economic impact of the WIC program may be measured through the close examination of total food expenditures and food purchase patterns. The former gives a clue to the variables affecting the family's budgetary allocation for food, while the latter shows how this allocation is spent among the different food groups.

Recall Data

The results from the recall data on total food expenditures indicate that household composition is the primary determinant of total food expenditures. For every additional adult in the household, food expenditures increase an average of $41 a month, while for every child this expense increases $28 a month. Moreover, for each additional guest residing in the household, total monthly food expenditures increase by almost $17. For every WIC child in the household, monthly grocery expenditures increase by almost $8.

Analysis of the effects of food assistance on total food expenditures, which include the cost of all food consumed regardless of its origin, showed Food Stamps to have a small but significant effect on food expenditures. For every additional dollar received in terms of Food Stamps, grocery expenditures increase approximately 12 cents.

Diary Data

The results of the analysis of the food purchase diary data reveal that, in terms of apparent differences in composition of the diet among the target population, the WIC program has achieved some success (see Table VII-3). Expenditures on WIC-type foods attributable to the WIC woman are $2.54 per week higher than for non-WIC women. Although this difference is not necessarily directly attributable to the WIC package, it suggests, at the least, the possible extent of the nutritional differences between program participants and nonparticipants.

Table VII-3 presents the statistical results from the diary data analysis. The table is divided into several columns representing the different food groups reported in the diary. These food groups in turn represent components of the market basket with declining degrees of im-

Table VII-3

Impact of WIC on Types of Food Purchased and on Types of Food Expenditures ($/Week)

Selected independent variables	Total expenditures	Grocery expenditures	Meals away	WIC-type foods	Non-WIC foods				
					Meats	Cereals and bakery	Vegetables	Fresh foods	Frozen foods
Intercept	62.15	52.13	10.03	8.46***	16.85	8.92***	9.79	25.32***	6.17***
Male head present	-7.27**	-6.98***	-0.30**	-1.66**	-1.96*	-1.60***	-1.18**	-2.78**	-0.84*
Children 0-5 years old	1.04	2.12	-1.08	1.07	0.03	0.51	-0.02	0.15	-0.18
Adults	8.14***	7.10***	1.04**	1.14***	2.35***	1.23***	0.87***	3.66	0.25
WIC	-3.34	0.75	-4.10***	2.54***	-1.25	-0.77	0.50	-1.24	-0.28
WIC*children	2.21	0.59	1.61	0.82	0.55	-0.38	-0.03	0.28	0.16
WIC*adults	0.20	-0.06	0.27	0.44	-0.23	-0.06	-0.08	-0.71	0.27
Lunch program	0.29	0.37	-0.08	0.03	0.10	0.04	0.03	0.14	0.04
Guests	4.79**	3.47*	1.32*	0.33	0.73	0.80	0.48	1.38	0.15
Food Stamps	-0.13*	-0.04	-0.08***	-0.01	0.02	0.00	-0.03**	-0.03	-0.00
Other WIC women	4.38	3.98	0.49	1.23	0.79	0.65	0.46	0.27	0.60
WIC children 0-5 years old	5.89*	5.82*	0.06	2.25**	0.29	0.95	0.32	-0.05	0.81

*p < 0.05.
**p < 0.01.
***p < 0.001.

Source: Food Purchase Diary Sample.

portance, based on nutritional value and program objectives. The fourth column (WIC-type foods) shows the results for food normally found in the WIC package; WIC women spend $2.54 more per week on WIC-type foods than non-WIC women. Children on WIC also account for higher WIC food expenditures than non-WIC children. WIC children under 5 years of age receive $2.25 more per week than non-WIC children. This finding is consistent with evidence obtained from the recall data, which show significant positive effects of the WIC children's component.

The results for the other food groups show some general trends that are fairly easy to interpret. Expenditures on meats, for example, primarily depend on the presence of adults in the household. Overall, the effect of the family's age-sex composition is the predominant force explaining food group expenditures. Food Stamps account for a very modest but significant effect on expenditures, which is consistent with the recall analysis and findings from other similar studies.

Program participation is associated with a reduction in expenditures of meals away from home of more than $4 a week, consistent with the recall data. As explained previously, this probably accounts for greater efficiency in the use of the family budget and is apparently attributable to WIC participation.

C. DISCUSSION

1. Impact on WIC Women

The evidence shows that program impact is felt mostly in terms of food composition rather than in terms of food expenditures. Participants in the WIC program buy more WIC-type foods (presumably more nutritious) than non-participants, even though no significant differences in total food expenditures were found between the WIC and non-WIC groups (see Figure VII-1).

The income elasticities* of food expenditures found among the WIC and non-WIC families are low but consistent with the elasticities found among similar socioeconomic groups in similar studies. For a WIC family, for instance, results indicate that an additional dollar of income will result in an increase of 12 cents in their grocery expenditures. Hence, if a monthly WIC package with an average value of $30 is given to a WIC family, their grocery bill would show an average increase of $3.60 a month. However, determining this amount as statistically significant was not likely with the given sample and survey design.

Unchanged levels of food expenditures, however, do not imply unchanged use of WIC-type foods. Expenditures on WIC-type foods among WIC families

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*Elasticity is a term used to indicate the degree of responsiveness of food expenditures to changes in income. If changes in income result in only very slight changes in the amount spent for food, then food expenditures have a low income elasticity.

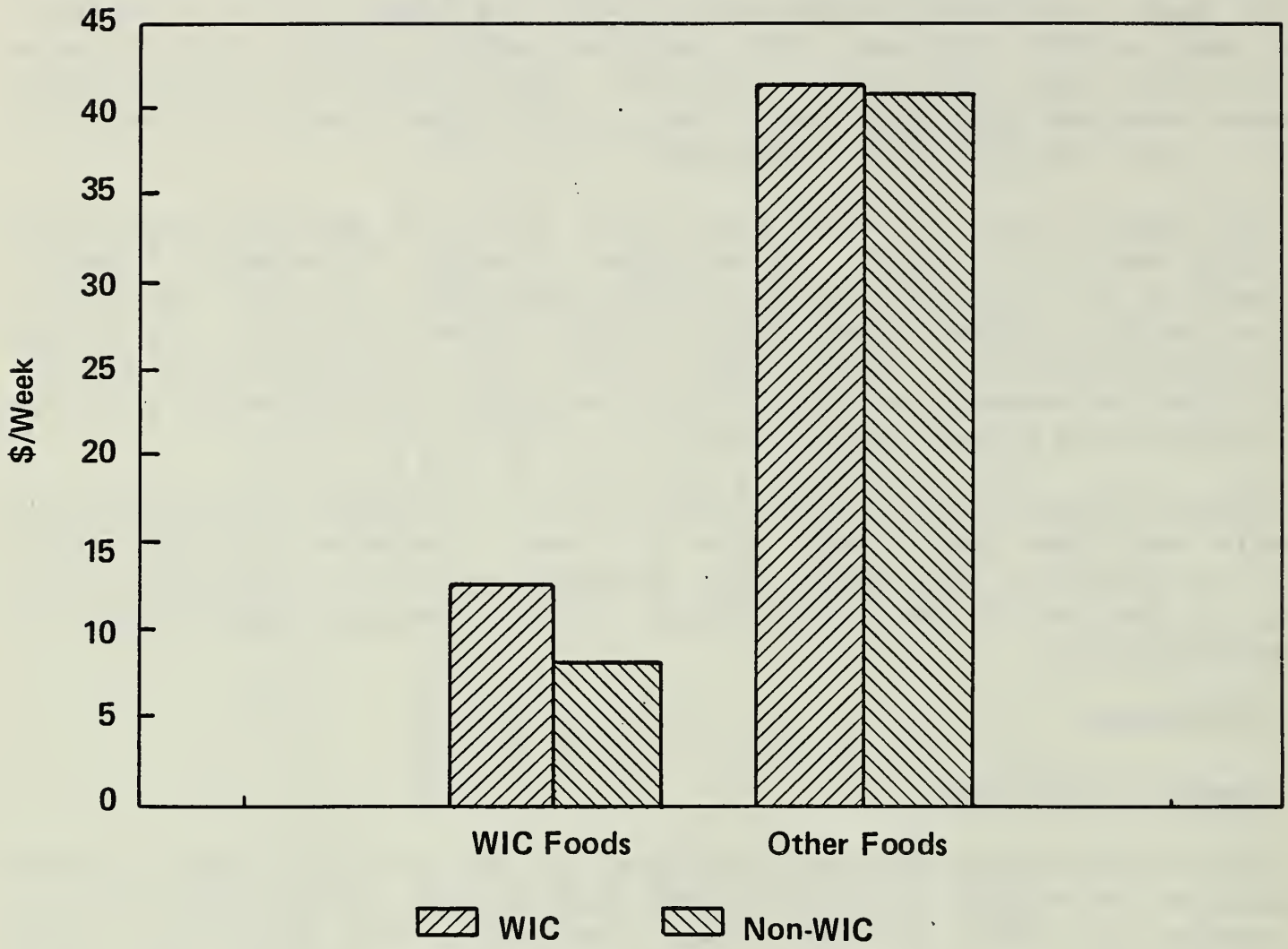

Figure VII-1. Weekly food expenditures (by food group).

are significantly greater than among non-WIC families as shown by the diary data. Although there is no direct evidence that such expenditures are derived from program participation, indirect evidence is provided by the fact that expenditures in other food groups are the same for WIC and non-WIC families. Hence, the evidence suggests a positive programmatic impact in increased use of nutritious WIC-type foods. Furthermore, this increment in WIC-type foods is unequivocally attributable to the WIC woman.

2. Impact on WIC Families

The impact of the WIC program on unintended recipients seems to be negligible. However, unlike the case of WIC women, the program for WIC children has significant and positive effects on both food expenditures and purchasing patterns. The statistical evidence gathered from the recall model shows that children participating in the WIC program are responsible

for an increase in grocery expenditures of over $7 a month. In the diary data, WIC children less than 5 years of age account for $2.25 more on WIC food expenditures than do non-WIC children. The significant effect of WIC foods purchased for the consumption of children may be due to differences between foods for children and foods purchased for the consumption of adolescents and adults.

D. CONCLUSIONS

The main conclusions of this study of WIC's impact on food expenditures and purchasing patterns are summarized as follows:

Expenditures on WIC-type Foods

Based on diary records, WIC families show significantly higher expenditures on WIC-type foods than non-WIC families do. Moreover, this higher expenditure level is directly attributable to WIC program participation. Significant effects on use of WIC-type foods are found among WIC women and WIC children less than 5 years of age. These effects were approximately equal for both women and children. Total food expenditures and expenditures on other food groups were not found to be statistically different among WIC and non-WIC families.

Substitution and Sharing

Analysis of the recall data indicates that the value of the WIC package is almost totally substituted and that no sharing has occurred. An important caveat to this conclusion is that the survey power was insufficient to detect as significant levels of expenditures lower than one-sixth of the value of the average WIC package.

Meals Away from Home

Families in the WIC program spend less on meals eaten out than do non-WIC families, even after the increase in real income brought about by WIC. Because participation in the WIC program is strongly associated with lower expenditures in meals away from home, the family budget's efficiency apparently increases.

Age-Sex Composition of Family

The family age-sex composition is the primary factor explaining family food expenditures, with gender and age accounting for most of the differences found among family members. As expected, children have smaller effects on food expenditures than do adults and females have smaller effects than do males.

Quality of Diets

Increased expenditures on WIC-type foods and evidence of lower expenditures on meals away from home indicate potentially more nutritious diets

and improved nutrient quality of the diets of participants. The findings of the Food Expenditures Study, therefore, appear consistent with the effect of WIC benefits on dietary intake. As was shown in Chapter III, the quality of the diet (the nutrients) increases with WIC participation.

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